MUSICAL CREATIVITY

Multidisciplinary Research in Theory and Practice

Irène Deliège and **Geraint Wiggins**

Musical Creativity

This collection initiates a resolutely multidisciplinary research dynamic specifically concerning musical creativity. Creativity is one of the most challenging issues currently facing scientific psychology and its study has been relatively rare in the cognitive sciences, especially in artificial intelligence. This book will address the need for a coherent and thorough exploration.

Musical Creativity: Multidisciplinary Research in Theory and Practice comprises seven sections, each viewing musical creativity from a different scientific vantage point, from the philosophy of computer modelling, through music education, interpretation, neuroscience, and music therapy, to experimental psychology. Each section contains discussions by eminent international specialists of the issues raised, and the book concludes with a postlude discussing how we can understand creativity in the work of eminent composer, Jonathan Harvey.

This unique volume presents an up-to-date snapshot of the scientific study of musical creativity, in conjunction with ESCOM (the European Society for the Cognitive Sciences of Music). Describing many of the different aspects of musical creativity and their study, it will form a useful springboard for further such study in future years, and will be of interest to academics and practitioners in music, psychology, cognitive science, artificial intelligence, neuroscience and other fields concerning the study of human cognition in this most human of behaviours.

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Edited by
Irène Deliège and Geraint A. Wiggins

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Preface

Creativity, alongside awareness and intelligence, is one of the most difficult issues currently facing scientific psychology. Study of creativity is relatively rare in the cognitive sciences, especially in artificial intelligence, where some authors have sometimes actively argued against even beginning a research programme. Nonetheless, in recent years, some success has been achieved.

However, much of this success has been in areas of creativity related to science, architecture, visual arts and literature (or at least "verbal" activity). Music has not often been viewed as an object of study in the creativity field, except in the area of education, which is surprising, because in at least one sense it has a major advantage: it is usually possible to study music and musical behaviour without the added complication of referential meaning, which, while it may illuminate the output of other creative processes, also may obfuscate the mechanisms that underpin them.

The objective of this anthology is to help initiate a research dynamic specifically concerning musical creativity. To this end, its content is resolutely multidisciplinary, in the spirit of openness that has animated the European Society for the Cognitive Sciences of Music (ESCOM) since its foundation. Nevertheless, the volume should not be taken as a "handbook". It should be viewed more as a source of ideas, research topics to start on, to follow up, or to develop.

The collection comprises seven sections, each viewing musical creativity from a different scientific vantage point, from philosophy, through the increasingly reified activities of listening, performance, education and therapy, via neuroscience, to computational modelling. Each section contains proposals, discussions, and theoretical or review chapters by eminent international specialists on the issues raised.

The material presented here has been developed from the proceedings of a conference held at the University of Liège in April 2002 on the occasion of the 10th anniversary of the founding of ESCOM.

It had long been planned that this event would be celebrated in the birthplace of the society, at the University of Liège. In fact, it was in December 1990 that the ESCOM Founding Committee had a meeting in the department of Professor Marc Richelle at the Faculty of Psychology. This committee

consisted of Mario Baroni, Irène Deliège, Kari Kurkela, Stephen McAdams, Dirk-Jan Povel, Andrezj Rakowski, and John Sloboda. With the help of lawyer Philippe Dewonck, this committee founded the society and drafted its statutes and internal rules over the course of two days of work and discussion.

Following on from this, a general assembly was called, to which the founding members were invited, with the dual purpose of putting to the vote the articles and statutes proposed by the Founding Committee and electing the first ESCOM Executive Committee. This first general assembly was held at the University of Trieste in October 1991, at the conclusion of a three-day conference.

We sincerely thank our distinguished colleagues who made the 10th jubilee an outstanding event in the development of ESCOM and for their updated and polished contributions of the chapters in this publication, providing a permanent record of the event.

The papers published in this book were all subjected to a rigorous review process. The editors would like to offer their warmest thanks to those who have contributed to this onerous task: Eckart Altenmüller, Mario Baroni, Elvira Brattico, Warren Brodsky, Roger Chaffin, Nicholas Cook, Roger Dannenberg, Jane Davidson, Jos De Backer, Irène Deliège, Goran Folkestad, Enrico Fubini, Alf Gabrielsson, Marie-Dominique Gineste, Maud Hickey, Michel Imberty, Colin A. Lee, Jean-Luc Leroy, Scott Lipscomb, Martin Lotze, Björn Merker, Janet Mills, Raymond Monelle, Oscar Odena, Suzan O'Neill, Johannella Tafuri, Neill Todd, Mari Tervianiemi, Petri Toiviainen, Colwyn Trevarthen, Geraint A. Wiggins, Tony Wigram, Aaron Williamon, Betty-Anne Younker and Susan Young. The editors also thank their editorial assistants, Ollie Bown, Alastair Craft, David Lewis, Dave Meredith, and Christophe Rhodes. We are grateful for the support in kind of Goldsmiths College, University of London.

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I.D. & G.W.

Prelude

The spectrum of musical creativity

Irène Deliège and Marc Richelle

Musical creativity is fascinating subject matter for all those interested in human creativity – whatever that means – and for all those interested in music, be they composers, performers, listeners, or experts in one of the many facets of the art of sound. This makes for a rather wide and diverse group of people, who ideally should attempt to work in close collaboration. Such a multidisciplinary approach is slowly emerging, and hopefully will eventually succeed in elucidating some of the many mysteries concerning the nature and origins of creative artefacts, which we so much admire and enjoy though we still understand so little how they become part of our world.

The present chapter is not aimed at reviewing all the (generally unanswered) questions that have been raised in various subfields of the study of creativity. We shall limit ourselves to a few of them, from the point of view of psychologists, not of "psychology", because these authors may not be typical of the average representative of a science still lacking unity, let alone consistency (for a survey of the current state of affairs in psychological research on creativity, see Sternberg, 1999).

With a few exceptions, psychologists were not very interested in creativity until the middle of the last century. They were somewhat shaken by the presidential address given in 1950 at the American Psychological Association meeting by Guilford, under the title "Creativity" (Guilford, 1950). This suddenly fostered research, books and debates on creativity. The abundant work in the field over the 55 years since Guilford's lecture appears to be somewhat disappointing to many outsiders, and to many psychologists as well. Several contributors to the present volume share this discontent in the introductory sections of their papers, and eventually turn to other routes in the hope of solving problems left unsolved by psychologists. Some are confident that artificial intelligence will help, with more or less sophisticated formalisation; others expect illumination from neurosciences; still others simply suggest a return to subjective experience. Dissatisfaction with the outcomes of psychological research and discourse might be sheer impatience: half a century of even intensive work is perhaps too short a period of time in which to elucidate one of the most challenging issues of psychology, as is the case for

other issues, such as consciousness. It may be that psychology has been putting too much energy into exploring blind alleys.

One dominant feature of creativity research in psychology has been the emphasis on creativity as a component of intelligence, presumably of innate or inherited nature. Guilford, being an expert in testing and factor analysis, developed procedures to measure creativity, and proposed the concept of *divergent* as opposed to *convergent* thinking. It was assumed that a special aptitude, labelled *creativity*, is measurable *per se*. The obvious fact that creativity is always in one specific domain, using a certain material, resulting in some type of product, was ignored. As a consequence, individuals with high scores in tests of creativity were reputed to be creative, irrespective of their creative activities in real life. And conversely, individuals producing original pieces of painting, writing or music were said to exhibit creativity, which does not tell us much about the *why?* and *how?* We might, more straightforwardly, look at those behaviours that eventually lead to novelty in a given field of arts or sciences, and try to account for them by identifying the processes involved. In simple terms, get rid of *creativity*, and look at *creative acts*.

Some attempts have been made to describe the processes at work in creative acts. One appropriate way to have access to them would be to ask persons who have engaged in acts of creation to report on their experience. The present volume offers an example of that approach, due to composer Jonathan Harvey (for whose collaboration we are grateful). Such material is available in a number of artists, musicians, and scientists' writings on their own creative behaviour, and is undoubtedly a source of insight that the psychologist cannot ignore. However, we know the limits of introspection, and that subjective reports do not tell us the whole story; moreover, the more complex the processes at work, the less amenable they are to the person itself. In a frequently referenced classical model of what is going on in creating, four successive phases are distinguished, viz., *preparation, incubation, illumination*, and *elaboration*. These are rather broad labellings, which demand substantiation. The model derives essentially from reports by mathematicians, and conflates creative acts with a situation of problem solving, a widely accepted interpretation in the currently dominant cognitivist paradigm. Significant in this respect is the treatment of *creativity* in a recently published scientific encyclopaedia: the main entry is *creativity and cognition*, suggesting that it is not worth talking about creativity if it is not related to cognition (other entries are on applied domains of creativity training and management of creativity) (Smelser & Baltes, 2001). Reducing creative activity to cognition is questionable. Clearly, pieces of art, literature, or music are more often than not emotionally loaded. Is emotion also an ingredient of creative acts? This is a different question. As Diderot argued in the comedian's paradox, emotion can be produced in the spectators by the actor playing his or her role in a purely technical way, void of any emotion. Were this generally the case, the hypothesis of creative acts as problem solving might find some support. But problem solving might have its genuine emotional facets, intrinsic to the very

act of creation, not directly linked with the emotion evoked in the receptor. This emotional component of problem-solving/creative acts is certainly not easy to appraise. It might turn out to make for the irreducible difference between human behaviour and machine-generated creations, a question now under scrutiny by experts in artificial intelligence.

One major methodological difficulty in the study of creative acts is the time dimension. Supposing adequate tools are available, when exactly shall we apply them? In other words, at what point in time does the sonnet begin in the poet's mind, or the symphony in the composer's brain? And how does the process develop in time? Is it continuous or discontinuous? Is the time spent putting letters or notes on a piece of paper more or less important than the time spent before, maybe long before, in essential activities that leave no observable traces?

If, as mentioned above, we think it heuristically preferable to speak of creative behaviour or acts rather than of creativity, we are led to focus on features specific to various domains rather than related to some hypothetical general disposition. Music has its specificities, as compared with other fields of arts and sciences. Painting and sculpture, at least in the figurative tradition, as well as natural sciences are submitted to the world outside; they work within the constraints of the objects to be represented or explained. Writers work under the constraints of the language they use. Composers use sounds, their raw material, in complete freedom, in the sense that they arrange them at will, without any constraint from the organization of sounds and noises in "real life"; their limits are in the instruments available to them to serve as vehicle of their music and in the receptor, i.e., the human ear's capacities. Their situation as creators is in that respect more akin to formal science and mathematics than to empirical science or other arts. In fact, many of them have viewed, and still view, their own activity as very close to mathematicians' work, and throughout the history at least of Western music, they have elaborated very sophisticated systems of rules. Like mathematicians, they have been confronted with the puzzling question of the status of their products: are they constructions generated by their creative activity, or unveiling of hidden objects of a non-material nature existing in an unknown space? The question has not been solved in mathematical circles (see Changeux & Connes, 1989, and Richelle, 1990, for their debate), and remains unsolved among musicians. In both fields, the idea that musical or mathematical objects are unveiled, discovered, rather than constructed contributes to maintaining the appeal to inspiration, in a strict sense, as an explaining factor. A biologist might have insight into the process of discovering some new relation, but would never admit being *inspired*; a painter, even working in the most abstract style, would deny that what is on the canvas was somewhere before he painted it. The obvious rapprochement between music composition and mathematics also appears in two other features, at first sight contradictory: on one hand it so occurs that mathematical objects admirably fit physical reality, and that musical models reveal unsuspected adequacy with the

biological characteristics of the auditory system; on the other hand, in both cases, creators may venture into constructs that challenge any link with reality – as in geometry with *n* dimensions, or music imperceptible to the human ear.

Another specific feature of music has a major impact on the concept of musical creativity and on related research. In contrast with painting, sculpture and literature, in which the artistic message goes directly from the producer to the receiver, music is in most cases a threefold event: someone, the performer, has to play the piece of music to convey it from the composer to an audience (composers playing their own pieces and listeners playing for their own pleasure are just special cases of plurality of functions). Except for expert musicians who might enjoy music more by reading the score than by attending concerts, music needs an audience, and an audience needs interpreters. Creative behaviour takes place at all three levels, and is the object of concern for researchers, who are devoting increasing attention to the case of interpreters. These are expected to provide the listener with a performance that does not mechanically reproduce another interpreter's performance, while respecting the composer's work; the margin of freedom is extremely tight, which makes the creative component all the more impressive. The interpreter's situation, by its peculiar constraints, would seem especially appropriate for scientific enquiry, including computer simulation exploring the possibility of substituting the computer for the human interpreter as a source of creative performance.

The challenge of creative machines, such as computer performance, confronts us once again with the issue of the very possibility of accounting for creative behaviour in scientific terms. The question is still present in current research on creativity, as it is in the equally popular domain of consciousness research: is there any continuity from elementary processes of adaptation and problem solving in animals, including humans, to the fantastic outcomes of creative activities in human cultures? Looking at their complexity and diversity, at their aesthetic and gratuitous character, and at their mysterious origin, one is tempted to put them in a qualitatively distinct category, incommensurable with anything at the lower levels. Going one step further, one might question, or deny, the possibility to account for them in a scientific approach. Creativity, as consciousness, or part of it (see, for instance, Chalmer's, 1996, view on consciousness), would map a territory not amenable to scientific analysis, and would eventually define the irreducible core of human nature. For those who reject such a dualistic view, and keep betting on the scientific approach, it remains to demonstrate the links between creative activities and adaptive behaviour at lower levels, and to elaborate a theoretical framework integrating continuity and emergence of higher order complex behaviour. At the moment, such a framework is offered by the biological evolutionary theory and the key concepts of variation/selection. Once limited to the evolution of species, and sometimes abusively applied to human society for ideological purposes (nineteenth-century "social Darwinism"), selectionist

approaches have been extended in recent decades to ontogenesis in various fields of biology (especially immunology and neurobiology; see Edelman, 1987, and Changeux, 1983) and to behavioural sciences (see Piaget, 1967, and Skinner, 1981, 1985), substantiating what has until recently been just a metaphor (see Popper's, 1972 evolutionary view of knowledge). Along these lines, and for what behaviour is concerned, variability is a crucial property of the organisms, providing the material upon which selection can operate, resulting in the shaping of behavioural novelties and in the emergence of increasingly complex activities, eventually categorized as *creative* (Richelle, 1987, 1990, 1991, 1993, 1995, 2003; Richelle & Botson, 1974). Living organisms, at the level of the species, of the individual or of culture, are, so to speak, generators of diversity, and therefore exposed to changes, for better or worse. Throughout all adaptive behaviour, from the simplest to the most elaborate, the basic processes are the same, and account for the extraordinary complexification and diversification we observe in human activities, as we observe them with wonder in the display of living species. In a very deep sense, nature and humans can be said to be creative.

Besides the central issue of production of novelty at the highest level in arts and sciences, the word *creativity* has been widely used in education at large and in individual development. This was part of the general movement, in the 1960s, questioning the traditional style of school teaching as being too rigid and putting emphasis on reproduction of things known rather than on discovery of new things. This was based on the assumption that each individual is born with a creative potential that schools and other educational agencies inhibit. The mythical belief that giving this potential freedom to express itself would result in the proliferation of genius was not really fulfilled. However, impetus was given to endeavours towards more flexible approaches in teaching. So-called creativity training has been widely proposed as a source of more efficient learning and self-satisfaction, even in helping people with physical or mental handicaps. Assessing scientifically the outcomes of such efforts is a difficult task, but it should not discourage one from pursuing them; however modest the benefit might be for the individual concerned, it is worth the energy invested.

These are but a few issues in the broad area of creativity research. Contributions in the present volume address some of them, and many others. They do not bring definitive solutions to any of them: such an optimistic outcome is still far from being attained. One important point is that they provide a variety of perspectives, methods and goals. They bring together musicians of various kinds, people in (general, musical, special) education; in artificial intelligence; in philosophy, sociology, psychology, neurosciences; in psychotherapy; etc. There is no hope of understanding creative behaviour by looking at it from one discipline, using a single methodological approach even within a given scientific field. Hyper-experts confined to their own monolithic model have little chance of success. By its very nature, creativity requires confrontation, debate, questioning, integration.

Opening the doors to fresh air from all sides, it requires genuinely creative intellectual exercise.

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Part I

Creativity in musicology and philosophy of music

1 Playing God: Creativity, analysis, and aesthetic inclusion

Nicholas Cook

1.1 Theory of music or theory of creation?

There is a certain passage – it doesn't matter which – in Beethoven's Sonata Op. 14 No. 2 in which the composer, when he played it, "expressed the reaching over of the sixths . . . by holding the cover tone of each sixth beyond its written value, so that it continued to sound for an instant beneath the higher tone which follows."[1] At least, so the early twentieth-century musician and theorist Heinrich Schenker tells us, conjuring up a vivid image of the composer – who, after all, died half a century before the invention of any kind of sound recording – through what seems to be a kind of music-theoretical spiritualism. Yet Schenker's account of the tiniest nuances of Beethoven's playing, which is also an account of Beethoven's intentions as expressed in it (to express "the reaching over of the sixths"), is only a particularly striking example of a way of writing about music that is so ubiquitous in the analytical literature that we hardly notice it. "For a longer time than in any work he had written until then," says Charles Rosen (1976, p. 267) of the Quintet K. 515:

> Mozart avoids a real movement away from the tonic: he transforms it into minor, he alters it chromatically, but he returns to it decisively again and again before moving to the dominant. His powers of expansion – the delay of cadence, the widening of the center of the phrase – are called into play on a scale he had never before known.

There is nothing exceptional about what Rosen is saying; it's a quite standard analytical description – and yet, when you think about it, it is strange. Even more than Schenker's past tense, Rosen's present tense – Mozart transforms the mode into minor, he alters it, returns – spirits the composer into the reader's presence. If there is a literary genre on which analysis draws in such passages, it is the ghost story.

The discourse of analysis, then, is pervaded by the language of compositional creation, of composers trying this, rejecting that, choosing the other. And when I say "language" I mean it even at the level of vocabulary.

The term "motive" provides an example. At one level this is simply the musical version of the art-historical "motif", an essentially neutral designation of an element of design, but throughout the nineteenth century the term acquired increasingly strong psychological overtones. Like so much else in modern analysis, this process has its origins in early nineteenth-century critical responses to Beethoven, many of which were in effect apologias for the perceived strangeness of his music, attempting to explain – or explain away – this strangeness in terms of Beethoven's personal circumstances, his medical afflictions, his aesthetic premises and artistic intentions: in a word, his motives. But the link of analytical postulate and psychological connotation becomes much closer in the twentieth century. What we now refer to as "motivic analysis", that is to say the approach associated primarily with Schoenberg and his followers, is "motivic" in both these senses: Schoenberg (1975, p. 222) used it to demonstrate how the linkage of materials could be "a subconsciously received gift from the Supreme Commander", as he put it in relation to the two principal themes of his First Chamber Symphony (1906). The idea of motives being the vehicles of the unconscious was worked out more explicitly in the writings of Rudoph Réti, Hans Keller and Anton Ehrenzweig – it is no coincidence that all these writers, like Schoenberg, were long-term residents of the same city as Sigmund Freud. It is also worth mentioning in passing that the idea of contents welling up from the unconscious is closely linked with the idea of musical inspiration, at least according to Jonathan Harvey (1999, p. 3), for whom "inspiration *requires* the involvement of the unconscious mind".

Today, however, the most familiar analytical system in which an implicit creative orientation plays a foundational role is Schenker's. It is this, after all, that explains the often remarked fact that Schenker did not set out his theory as one of musical analysis at all, but as one of musical synthesis. Analysis means starting with the music you want to analyse, and working through to whatever reduction or other analytical destination you have in mind. But in *Free composition* (1979, originally published 1935) and elsewhere, Schenker does the opposite: he begins with the *Ursatz*, with the raw material of tonality, and works through to the actual music in question, detailing the successive layers of transformation in which the substance of his theory lies. In this sense the theory provides a kind of "composer's-eye view", and Schenker was the first major theorist to devote serious and sustained attention to composers' sketches and autographs: sketches, he said, "reveal musical coherence in the process of evolution" (Schenker, 1979, p. 7). He continues:

> What a deplorably low value is generally placed on music is reflected in the fact that sketches by the masters, although long a commercially viable commodity, have been little understood by musicians . . . How different is the case of the first drafts, fragments, or sketches of great poets and painters – they have always met with a more general and lively appreciation!

Nor is this the only sense in which the composer's-eye view is central to Schenker's theoretical conception. At one point in *Free composition* (1979, p. 18), he writes that:

> The fundamental structure is always creating, always present and active; this "continual present" in the vision of the composer is certainly not a greater wonder than that which issues from the true experiencing of a moment of time: in this most brief space we feel something very like the composer's perception, that is, the meeting of past, present, and future.

This idea of the creative moment, the flash of inspiration, takes us to the heart of Schenker's theoretical conception. As early as 1894 – that is to say, well before he developed what we now think of as his theory – Schenker wrote that:

> In the literature of music there are works that came about in such a way that within the endless chaos of fantasy the lightning flash of a thought suddenly crashed down, at once illuminating and creating the entire work in the most dazzling light. Such works were conceived and received in one stroke, and the whole fate of their creation, life, growth, and end already designated in the first seed.[2]

This Romantic conception of creative inspiration has become a commonplace, even a cliché. It is nevertheless a conception of strictly historical scope, as evidenced by the fact that its earliest and most famous expression – attributed to Mozart and quoted as such by Schenker in *Free composition* – has long been known to be a nineteenth-century forgery (Solomon, 1988): it put into Mozart's mouth the words that Romantic aestheticians would like him to have uttered.[3] At the same time, this Romantic conception of creation builds on the eighteenth-century idea of the genius as someone through whom a higher agency speaks, another idea that composers from the late eighteenth century on have reiterated when describing the creative process: Harvey (1999, pp. 153–154) cites Haydn, Weber, Brahms, Richard Strauss, Schoenberg and Stravinsky. Schoenberg's reference, which I have already quoted, to "a subconsciously received gift from the Supreme Commander" effectively identifies God with the unconscious mind, and a rather similar constellation of ideas is to be found in Schenker:

> Included in the elevation of the spirit to the fundamental structure is an uplifting, of an almost religious character, to God and to the geniuses through whom he works . . . Between fundamental structure and foreground there is manifested a rapport much like that ever-present, interactional rapport which connects God to creation and creation to God. Fundamental structure and foreground represent, in terms of this rapport, the celestial and the terrestrial in music.[4]

Here, then, the background is identified with God, just as Schoenberg identifies the unconscious with God: complete the syllogism and we have the identification of the Schenkerian background with the unconscious – an identification that Schenker never quite spells out, but that is hard not to posit, if only through an association of ideas (and of course, Schenker was another resident of Freud's Vienna).[5]

But this jigsaw is missing a piece, which was supplied a few years back by Peter Kivy. Kivy (1993, p. 189) asked where, if not in Mozart's letters, Rochlitz found the lastingly compelling image of musical creation he put forward ("the whole . . . stands almost complete and finished in my mind, so that I can survey it, like a fine picture or a beautiful statue, at a glance. Nor do I hear in my imagination the parts *successively*, but I hear them, as it were, all at once."). Kivy found the answer in the parallel between human and divine creation or, to be more specific, in the theological chestnut about how God, who is unchanging and eternal, conceives or apprehends historical change. Boethius solved the conundrum by saying that "just as you can see things in . . . your temporal present, so God sees all things in His eternal present"; similarly, St Thomas Aquinas argued that the divine intellect "sees, in the whole of its eternity, as being present to it, whatever takes place through the whole course of time" (Kivy, 1993, pp. 196, 197).

Kivy's argument, obviously, is that this is the source of Rochlitz's idea of musical creation transcending time, but the resonance between the theological argument and Schenker's theory is even more striking: it is the concatenation of musical and divine creation that gives us the model of Schenker's genius-composer, the authentically creative individual whose "continual present" lies at the junction between past and future, and who grasps the "tonal space" of the musical background,[6] so transmuting it through the compositional devices of prolongation into perceptible sound – and who is thereby distinguished from the non-genius, the perhaps talented but fundamentally uncreative individual who remains bound to the musical surface, plodding on from one note to the next. And when, in another of the passages I have already quoted, Schenker wrote that "there are works that . . . were conceived and received in one stroke", the implication is that there are other works that were not; if not in 1894, then at a later stage Schenker saw this as the dividing line between the works of genius and the rest: "between the two groups," Schenker (1994, p. 113) wrote, "lies an unbridgeable chasm". I have already described Schenker's theory as one of musical synthesis rather than analysis, but now it becomes necessary to gloss the term "musical": as has often been pointed out, Schenker's theory is not about music in general, but about musical masterpieces. It aims to recover the original vision, the "lightning flash" in which the work was revealed, and for that reason can gain purchase only on such works as were conceived in such a manner. Putting these various definitions together, we might say that it is not a theory of music but of creative mastery in music.

While I have been concerned to spell out the detail of some specific links

between Schenkerian analysis and concepts of creation, there are broader links as well. Speaking loosely but not misleadingly, one might say that Schenker's approach drew on the complex convergence of ideas that gave rise, around 1800, to the modern concept of the musical work,[7] and with it a basic aesthetic attitude borrowed from the literary and fine arts: to understand music is, in Stephen Davies' (2001) phrase, to understand it as the work of its creator – and analysis can contribute to such understanding by helping the music-lover to experience it as that, rather than as "merely another kind of amusement", to borrow Schoenberg's (1975, p. 220) withering phrase. But at this point things get a little confusing. After all, it was the same understanding of music as the work of its creator that led, in the second half of the nineteenth century, to the approach to music that Schenker most detested: the kind of biographical, if not anecdotal, interpretation for which he particularly condemned Hermann Kretzschmar. Schenker's Ninth Symphony monograph (1992, originally published 1912) is as much as anything else a diatribe against the kind of informal commentary through which writers like Kretzschmar sought to introduce the classical canon to enthusiastic but technically uninformed listeners, the tone of which is sufficiently represented by Schenker's (1992, p. 159) comments on the beginning of the *Scherzo*:

> Kretzschmar would undoubtedly have fared better if, instead of the plethora of words – "brief moment", "happy frolic", "elements of weary longing", "stifled", "cheered on", "forceful strokes" – he had . . . provided concepts of truly orientational value, such as "modulatory theme", "second theme", and so forth.

In essence, to anticipate the conclusion of my argument, Schenker (and analysts more generally) aimed to remove the composer from the work while retaining the traces of creative intentionality. Where a modern reader of Schenker may be struck by the vestiges of Romantic metaphysics in his thought, contemporary readers were rather struck by the technical density and almost mathematical jargon of his writing; seen in this light, one might reasonably think of his work as anticipating that of such post-war American theorists as Allen Forte, with their emphasis on objective modes of analysis – which in turn entailed an understanding of the musical work as some kind of structural entity (it was after all this affinity that made possible the extraordinarily comprehensive, if skewed, assimilation of Schenker's thought into post-war American theory – an assimilation in which Forte played a leading role). The determination to understand music as structure and only as structure – to find everything worthy of analysis in the musical object – is also directly comparable with the anti-contextualism of the "New Criticism" in literary studies; just as the New Critics ruled out as improper interpretations based on authorial intention, so the Beethoven scholar Douglas Johnson (1978) drove a wedge between musical analysis and sketch studies: if sketches contained an analytical linkage you were already aware of then they told you

nothing new, he argued, whereas if they brought to light a relationship that was not already part of your experience of the music then it could not be seen as of analytical significance. He asked rhetorically "Is there a single important analytical insight derived from the sketches which has become common knowledge among musicians?", and answered, "Not that I am aware of" (Johnson, 1978, p. 13).

All this might look like a decisive turn away from an aesthetic interest in musical works as the works of their creators, and towards understanding them as autonomous texts. But such a distinction does not stand up, and not simply because Johnson's arguments were by no means universally accepted. The obvious objection is that the principal players appear on both sides of the fence: Schenker, as the original proponent of both structural analysis and sketch study; Forte, as the leading practitioner of apparently objective and even computational analysis after the war, who also wrote a book (1961) on Beethoven's sketches for the Sonata Op. 109. Forte's book is particularly telling in this context. Its aim is very much what Schenker had in mind: to "reveal musical coherence in the process of evolution", and at the same time to use Schenkerian methods in order to make sense of the sketches. By the standards of subsequent Beethoven scholarship (Johnson's included), Forte's grasp of the chronology of the sketches was primitive, but it is hard to see that a more sophisticated understanding of this would have made much difference: for Forte, as for Schenker, it is the analysis that represents the rationale, the underlying logic – in a word, the *intentionality* – of the music, and to make sense of the sketches means to interpret them within that analytical framework. All the sketches can do is corroborate the intentionality inherent in the analysis. And that is an illustration of what I meant by analysis removing the composer from the work while retaining the traces of creative intentionality.

To put it more bluntly, the increasingly professionalized theory of the second half of the twentieth century may look like a theory of music, but is largely a theory of musical creation in drag. As I said at the beginning of this chapter, analytical writing is pervaded, much more than we commonly realize, by the language of compositional decisions and intentions, and even where this is not the case, the very conception of what there is to analyse in music – and therefore the framework within which the analysis is to be done – is informed by conceptions of musical creation, and debunked (Lehmann & Kopiez, 2002) conceptions at that. I have illustrated this in terms of the Schenkerian concept of fundamental structure or background, but the general point could have been made more simply: the aesthetic values that underlie most analytical work – coherence, complexity, vision – are those that emerge from the attempt to understand music as the work of its creator, to understand it, in short, as an expression of creative mastery. In the next section I draw out some of the consequences of this figuring of analysis, and consider some alternatives.

1.2 Resisting exclusion, relativizing theory

It was some 30 years ago, in his inaugural lecture at the University of Cambridge, that the composer Alexander Goehr (1977) described the idea of muzak – the form of canned music designed to optimize the working environment – as "composing backwards". By this he meant that you start with an intended effect (in the case of muzak, a temporal profile of excitation associated with high levels of productivity), and work backwards from that to the musical materials and organization through which it may be achieved – unlike in music, where you work forwards from the combination of musical materials to aesthetic effects that perhaps could not otherwise have been envisaged. The relationship between muzak and music is worth pursuing in some detail, because what distinguishes them is – perhaps more than anything else – the issue of whether or not the music is heard as the work of its creator.

Goehr's apparently innocuous distinction turns out to have some unexpected consequences. It turns on an idea – that of understanding music as the work of its creator – that I have traced to the aesthetic reformulation of the late eighteenth or early nineteenth century: it follows that there is no such thing as "early music", only "early muzak" – or that "early muzak" only became "music" when it was reinvented under the sign of the modern musical work (whether by Mendelssohn around 1830 or by Munrow around 1970). With few exceptions, the analysis and aesthetics of music are embraced within what has been the aesthetic ideology of Western "art" music since it was first adumbrated by Hanslick in the middle of the nineteenth century – an ideology that has certainly lost ground in the past decade or two, but without any particular credible alternative having emerged to replace it. Hanslick's central premise is exactly what Schoenberg echoed nearly a century later, that music is not merely another kind of amusement, and in *On the Musically Beautiful* (1986, originally published 1854) he invested considerable argumentation in distinguishing and distancing it from other forms of entertainment or sensory gratification ranging from hot baths to the imbibing of wine: his famous definition of music as "tones in motion" – in effect a licence for analytical practice – became (arguably through misinterpretation) an exclusionary strategy linked to the formulation of music as the work of its creator, for of course my argument in the first half of this chapter was that the composer-oriented and analysis-oriented approaches are intimately related. And since Hanslick's day the culture of Western "art" music has been upheld on precisely these grounds by numerous commentators, including not only Schoenberg and Adorno but also such English-language writers as R. G. Collingwood, Roger Sessions and Stuart Hampshire, all of whom emphasized the need for the listener to engage with music "by tracing the structure of the work for himself", as Hampshire (1969, p. 175) put it; in other words, through a process of compositional recreation. If you do not do this, says Hampshire, you are "treating the music only as entertainment".

It will come as little surprise that I want to question the thinking that, in effect, recognizes only (Western "art") music on the one hand, and muzak on the other – a position that reflects, in however distorted a manner, Schenker's "unbridgeable chasm" between the works of genius and the rest. In my book *Music, Imagination, and Culture* (Cook, 1990), I brought forward a range of evidence that many listeners listen to much music most of the time in what Walter Benjamin called a "distracted" state; that is to say, one of passive and predominantly moment-to-moment reception rather than the active and purposive engagement that Hanslick and Hampshire advocated. I suggested that one of the reasons people value music is the all-encompassing, oceanic, even coercive quality that this gives to the listening experience; Jerrold Levinson (1998) has argued more recently that most of the aesthetic pleasure we take in music can be accounted for on the basis of the moment-to-moment listening strategy he terms "concatenationist". Rose Subotnik's (1988) influential study of "structural listening" complemented this with an analysis of the ideological underpinnings of the attitude of active aesthetic engagement that has licensed analysis for the past century and a half. What all this adds up to is a historical mismatch between academic representations of music and its everyday consumption, which the entire project of "structural listening" attempted to rectify by making listening habits conform to academic prescriptions; the predominantly American term "ear training" vividly captures the peculiar blend of liberal education and behaviourist psychology that this involved.

In short, the idea of music as the work of its creator led to too exclusive an approach, one based on aesthetic prescription rather than on informed description of the practices through which people endow music with meaning in the course of their everyday lives. One way out of this, as my formulation suggests, is the kind of ethnographical approach to music in contemporary society pioneered by Marcia Herndon and Norma McLeod (1981) and Sarah Cohen (1991), but perhaps best represented by recent sociological work such as that of Tia DeNora (2000). By way of a short cut, however, it is helpful to draw a comparison with other aesthetic practices of everyday life, such as the enjoyment of wine (the very example that Hanslick set against music), scents, fashion, or cars. Wine and scents can be characterized in the same way as I characterized muzak: you work "backwards," to repeat Goehr's word, from the intended effect to the means by which it may be brought about. And at least in the case of scents, an understanding of the compositional process – the means by which the components are combined, refined, and structured – plays no role in the appreciation of the final product; after all, the ingredients are usually a trade secret. While the cases of fashion and cars are different in that they involve not purely aesthetic but (supposedly) functional objects, their aesthetic qualities are none the less real, and such material objects contribute massively to the aesthetic dimension of everyday life. Art collectors may be moved to spend millions by the shaping of a line or a particular pattern of brush strokes (or at least by the attributions they support, and

the consequent investment potential); for the rest of us, it is more likely to be the cut of the waist or the detailing of the headlamps that motivates the purchase. To withhold the term "aesthetic" from the objects and practices of everyday life is, it seems to me, to perpetuate a snobbish and outdated division between the "fine" and the "applied" arts, or between "art" and "craft"; it is telling that the concept of "commodity aesthetics" has been advanced by economists (Haug, 1987) rather than by aestheticians – and I would argue that until aestheticians embrace such a concept, they will not do justice to the cultural practices of everyday life.

But might a justification for withholding the term "aesthetic" from them perhaps lie in the absence, from the practices of everyday life, of the kind of discourse that develops appreciation and makes possible the kind of aesthetic debate and reasoning that distinguishes aesthetic culture? Such reasoning is central to Roger Scruton's aesthetics of art,[8] and it is through the medium of such discourse that the understanding of music as the work of its creator would re-enter the equation. But of course, unless we prejudge the issue through an excessively restrictive definition of the term, there *are* aesthetic discourses that surround the practices of everyday life. It is easy to make fun of the language of newspaper wine columnists when they speak of one wine displaying a touch of "leather and spiciness with supple-textured, raspberry-ish flavours", or of another as "an immensely rich and seductive blend . . . whose powerful green bean aromas lead to exotic undertones of lychee and a gooseberryish tang" (Rose, 2004a, 2004b): what exactly is the texture of a wine and how can it be supple, one might ask, and what is the logic by which green bean aromas "lead to" lychee undertones? Yet such carping misses the point: the fact remains that such writing is an effective medium of communication through which the enjoyment of wine may be shared, interrogated and criticised. Consumers read the reviews and shop accordingly, the critical vocabulary articulates and so consolidates the experience of the wine on the palate, and the result is an enlarged and increasingly discriminating public for wine (which in turn gives rise to improved standards in production). And there is a further respect in which such writing acts as a model of aesthetic discourse. Formally speaking, descriptions of wine of the sort I have just given set out causes from which effects are derived, or it might be more appropriate to borrow a phrase from Scruton and see them as constructing intentional objects,[9] but nobody when reading such a description thinks the critic is accusing the wine-maker of adulterating the product by adding fruit or animal hides to it: the language is understood as a purely metaphorical way of highlighting aspects of the wine's taste, aroma, or colour. It is also worth pointing out that the language is stylized and therefore historical (critics have *learnt* to write, and consumers to read, descriptions of wine in terms of such metaphors), and that it is very far from having a one-to-one relationship to the technologies of wine making.[10]

In saying all this I mean, of course, to suggest that much the same applies to music. Scott Burnham has documented how the kind of hermeneutical

commentary that Schenker associated with Kretzschmar, according to which music was heard to speak with its composer's voice, has survived into present-day aesthetic attitudes, most explicitly in relation to Beethoven's "heroic" style – but the values of the "heroic" style, Burnham (1995, p. xiii) argues, have come to be seen as those of "music" in general. Elsewhere (Cook, 2003), I have tried to suggest ways in which we might hear Beethoven's music (and in particular such "problem" pieces as *Der glorreiche Augenblick*) if we were to set aside the "Beethoven Hero" paradigm. In the present chapter I have tried to show how the same composer-oriented values ran underground, so to speak, in the twentieth-century analytical commentaries that eliminated the composer but retained the traces of creative intentionality. To the extent that such commentaries have presented themselves as anything more than descriptions of what is in the score, they are vulnerable to the standard critique of the intentional fallacy: we cannot know what composers *intended* except by means of deduction from what they *did*, and therefore the language of intentions adds nothing to the description of the score – it is, in short, an empty rhetorical gesture. Or perhaps not such an empty gesture, for I have not denied that we are interested in music as the work of its creator – only that we should see such an interest as aesthetically foundational – and so the language of creative intention plays a major role in our discourses for music. But the point is that, for all that, it is fictive, part and parcel of what Shibuya (2000) calls the "compositional persona": a metaphorical construction that may or may not coincide with the historical composer, but that can in either case regulate and coordinate the understanding of music of the Western "art" tradition.

The radically metaphorical discourse of the wine journalist, constructing a kind of fictive, parallel universe to the essentially ineffable experiences of taste and smell, might then be seen as a representation in miniature of the epistemological convolutions through which the physical, sensory, and affective experience of music has been accommodated within a logocentric culture. I have argued in another context (Cook, 2002) that epistemological slippage is a defining characteristic of music theory; a relatively small proportion of theoretical statements can be resolved into explicit hypotheses of cause and effect, a similar proportion boil down to factual assertions about composers, and a very large proportion seem to say something about both, but can be formulated neither as testable hypotheses nor as verifiable assertions. Yet the confident ascription of causality has long been a characteristic of analytical and aesthetic discourse. Schenker spoke explicitly of causality, and it is on that basis that he saw his theories and value judgements as aesthetically normative, as prescriptive rather than descriptive. Collingwood, Sessions, and Hampshire, in effect providing the rationale for the structural listening project, argued for a transformation of listening habits so that they would conform with the stipulations of post-Hanslickian theory: for them, the appreciation of music as art rather than entertainment meant understanding "tones in motion" as the causes of aesthetic effects. A more contemporary

parallel is provided by Fred Lerdahl (1988), who has similarly invoked theoretical constructs to argue for a transformation of practice, though this time the transformation is to be in composition, and not in listening: as is demonstrated by his reliance on the concept of "grammar" (compositional grammar, listening grammar), Lerdahl shares with the apologists for structural listening an assumption of the epistemological priority of theory, or more precisely of the psychological reality embodied in theory. Hence the demand that practice should conform to it.

If, on the other hand, we adopt a more pluralistic and relativistic view of theory, then such demands for conformance with one theoretical construct or another will seem less to the point. What might seem more to the point is a purely descriptive observation: there have been times and places at which there was a good fit between composition and theory (and other times and places at which there was not), and there are theories that link closely with composition and theories that do not. Here, by way of a concluding lightning tour, I shall attempt to place much of what I have been talking about in a different context. In the eighteenth century, what we would now refer to as "theory" consisted mainly of specifically composer-oriented manuals, for instance by Mattheson, Kirnberger, and Koch; even the more scientifically oriented theory of Rameau retained close enough links with compositional practice for the affinities and tensions with Rameau's own music to be evident. The nineteenth century saw a critical practice, addressed as much to a lay readership of aspiring listeners as to musicians, split off from more technical writing about music, which itself became increasingly institutionalized but nevertheless retained close links with compositional pedagogy in the work of, say, Marx and Lobe. It was with the development of theoretical projects orientated towards historical repertories that the link with compositional pedagogy became decisively weakened – as in the writings of Schenker, whose project might be described as the translation into technical terms of the nineteenth-century critical practice to which I referred. One might then trace a complementary development from Schoenberg to Babbitt and Lerdahl, in which music theory regained its formerly close association with composition, with a branching off to Forte, who on the one hand developed a non-compositional theory of Schoenbergian atonality, and on the other spearheaded the reinvention of Schenker for American academia. Seen this way, institutionalized theory, as practised most conspicuously in North America, consists of two broadly parallel streams, centred respectively around historical and compositional concerns. We have both a theory of music and a theory of musical creation.

Effectively dividing music into tonality and atonality, and music theory into Schenker and sets, this narrative is too pat: it leaves too much out, and forces too close an association of what it leaves in. It also glosses over the question of how far compositional theory represents "theory" at all, at least as that term is used by people outside music. Consider the position of Schoenberg, who, following his emigration to the United States, wrote a few

essays on 12-tone composition, but whose theoretical writing otherwise deals exclusively with historical repertories. It is telling that, after discussing some analyses by Schenker and Tovey, Goehr remarks "but Schoenberg's is the composer's approach" (1977, p. 19) – telling because, Goehr is talking not about any of Schoenberg's published theoretical works but about the unfinished *Gedanke* manuscripts (Schoenberg, 1995). And one of the most characteristic features of the *Gedanke* manuscripts – the one, moreoever, that most likely prevented Schoenberg from ever completing the project – is the openness, the fluidity, in fact the epistemological slippage, that results from Schoenberg's inability or unwillingess to tie down the musical "idea": it is at various times a motive, an object in musical space, a relationship between different musical elements, the means whereby balance is restored, and the totality of the work. It is hard not to feel that, had Schoenberg succeeded in rationalizing these divergent conceptions and drawing them into a consistent epistemological framework, the result would no longer have afforded the "composer's approach" to which Goehr refers. Even the most highly developed compositional theory, it seems to me – and I am thinking in particular of the work of Joseph Dubiel – retains something of this open, fluid, contextual quality, which militated against the construction of the grand theoretical systems after which Schoenberg seems to have hankered.

So, in the end, does the alignment of musical creation and theory represent the worst of all possible worlds, with debunked concepts of creation distorting analysis, and with theoretical approaches constantly threatening to impose a spurious closure upon the creative process? Are creativity and theory simply inimical to one another? That would be a depressing and retrogressive conclusion, taking us back to the simplistic opposition of "heart and brain in music" that Schoenberg was trying to get away from back in the 1940s, in his essay of that name (1975, pp. 53–76). And I think the way to avoid it is to openly accept how many different things can be embraced within the word "theory", at least as musicians use the term. In essence I have argued in this chapter that analytical and aesthetic theory has suffered from an unconscious conflation of the ideas of music and of musical creation, resulting in an approach that reiterates – as if it were applicable to all times and places – a historically and ideologically specific idea of musical creation; and I have argued that the result has been an aesthetic stance in relation to everyday life that is too exclusive, too restricted, to be taken seriously today. But the argument may apply just as well the other way round: the requirements of creative musical imagination may not be best met by the form of institutionalized theory that reflects the demands of academic accreditation and publication in today's professionalized environment.

Here is one way of making the point. All theoretical discourse is made up of a complex of metaphorical attributions (because that is true of all discourse), but in theory of the institutionalized type the metaphors are dead: their implications have been rationalized and systematized, absorbed into the larger theoretical construction. There is a convergence, so to speak, between

observation and explanation. By comparison, composers' discourse is characteristically marked by often graphic metaphors – practically any interview with Ligeti will supply abundant examples – that are not just live but kicking: they embody or prompt particularized ways of "hearing" sounds, ways that may resist conventional lines of least resistance (that's where the "kicking" comes in). Here we might talk of a divergence between imaginative perception and sedimented patterns of conception, or a bisociation between different attributive grids – and it's no accident that I am borrowing terms associated with the theories of creativity of Guilford (1979) and Koestler (1964). But above all, such metaphors are for single use only: as Dubiel (1999) makes clear, a compositional image is a way to hear *this* note in *this* context under *these* particular circumstances. The radical contextuality and evanescence of such compositional images means it may not be helpful to call them "theories" in the institutional sense (because that sets up unfulfilled expectations), but then the strength of Dubiel's work lies in showing how such contingent, single-use imagery can feed off and interact with the stable conceptual frameworks of institutionalized theory. That's the bisociation to which I referred.

Theory of music or theory of creation? In the end the two prove inseparable, partly because theory is itself implicated in the creative process, and partly because we still retain a tradition of hearing music as the work of its creator. But that is only one of any number of ways in which music is heard, which means that the very idea of "the" theory of music is problematic. By replacing "theory" with "theories", and by broadening our conception of what that term might embrace, we do better justice not only to the range of musics and musical experiences in today's society, but also to the contingencies of musical creation.

Notes

1 Translated from Schenker's unpublished *Kommentar zu Schindler* in Rothstein (1984), p. 19.
2 Translated from Schenker's "Eugen d'Albert" (*Die Zukunft*, *9*, 6, October 1894, p. 33) in Keiler (1989), p. 287.
3 Oswald Jonas, who prepared the second German edition of *Der freie Satz* from which the English translation was made, was aware of the problem, for he adds a footnote at this point: "This letter is generally thought to be a forgery by Rochlitz. However, the content and manner of expression point toward the possibility that it may record words spoken by Mozart" (Schenker, 1979, p. 129 n 3). Jonas offers no further evidence to back up his claim.
4 Schenker (1979), p. 160; this was one of the passages omitted by Jonas from the second edition of *Der freie Satz*.
5 Schenker was aware of Freud's work, two examples of which are included in his extensive collection of clippings, now in the New York Public Library (Kosovsky, 1990, pp. 310, 320).
6 "Only genius is imbued with a sense of tonal space" (Schenker, 1994, p. 113).
7 See Goehr (1992), but note that subsequent commentators have traced essential features of the work concept back as far as the sixteenth century.

8 See Scruton (1997), but also, for a clearer exposition of the basic issues, Scruton (1979).

9 "Much of music criticism consists of the deliberate construction of an intentional object from the infinitely ambiguous instructions implicit in a sequence of sounds" (Scruton, 1983, p. 109).

10 Readers wishing to pursue the argument of this paragraph may refer to Adrienne Lehrer's book *Wine and Conversation* (1983), a linguistic study of the discourses surrounding wine which presents and analyses a wide sample of English-language terminology: according to Lehrer, some terms correlate with particular physical properties of the wine while others form metaphorical clusters, and evaluation is deeply implicated in their usage. Lehrer monitored groups of subjects under different conditions, for instance over a series of sessions in which the same subjects repeatedly tasted and discussed wines with one another: objective tests of the subjects' identifications did not reveal significant improvements in performance over the sessions, but the subjects' own impressions were quite different (one commented, "I taste a lot more when I taste the wine now than I did before. Before, when I tasted them, I either liked them or didn't like them. Now I'm thinking of the body, or tartness, or astringency", Lehrer, 1983, p. 112). The author herself draws the parallel with music, writing on the penultimate page of the book that "I do not believe that wine conversation is unique . . . Investigating how people talk about music would be an interesting topic. Much of the vocabulary would be similar to that of talking about wine" (p. 218). While this may be true, I think the more striking similarities are at the level of discursive structure rather than vocabulary.

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2 Layered constraints on the multiple creativities of music

Björn H. Merker

2.1 Introduction

It should be obvious, but it is sometimes forgotten, that musical creativity cannot be defined without reference to the quality of the music it produces. If a greater degree of creativity does not result in a better piece of music, what is the meaning of creativity? And with that one might feel compelled to abandon the topic forthwith, because judgements about what constitutes good music are notoriously contentious. Since musical tastes differ, the question "which music?" immediately arises, and with it a descent into parochial preferences and acrimonious argument. This may account for the tendency to discuss musical creativity in terms of novelty or originality instead of the quality of the creation, a tendency reinforced by the value accorded to novelty and originality in contemporary Western culture. Yet if novelty were the only, or even the most important, dimension of musical creativity, we would be at a loss to explain why one would return to a piece of music after the first hearing (Belkin, 2002), or, indeed, why some pieces of music retain the power to fascinate audiences through centuries. Moreover, the prizing of novelty as an end in itself is not necessarily shared by non-Western musical cultures (see Napier, 2000), yet that does not allow us to conclude that these cultures are devoid of musical creativity. Musical creativity cannot be equated with the production of novelty any more than it can dispense with it altogether.

Command of craft and grounding in a musical tradition are no less essential to musical creativity than is originality, since for a creature of culture both adequate tools and command of tradition are prerequisites for producing substance. The importance of these issues notwithstanding, this chapter will discuss only preliminaries to the broader and more difficult questions of musical creativity raised by music aesthetics proper. In order for such a discussion not to diffuse into a consideration of creativity generally, one needs to consider music-specific aspects of creativity. These would include ways in which music differs from other arts and therefore might engage our creative capacities in special ways. They would also include general constraints and principles informing the structures of music in ways that bear on the exercise of musical creativity. I therefore mean to sketch a few such topics in what

follows – topics that help us focus on distinctly musical demands on creative capacities. The first of these is the fact that music is a performing art. Then comes a delineation of the core generative principle defining the pattern world within which musical creativity typically moves, and finally some additional constraints on that pattern world disclosed by recent research on primate tonality judgements.

2.2 The multiple creativities of a performing art

Music belongs among the *performing arts*, that is, a given piece of music typically does not originate during performance, and can be realized repeatedly in different performances. This circumstance sets music apart from some of the other arts, though not all of them, of course. The distinction is also rendered less than absolute by phenomena such as musical notation and electronic means of making music, since they allow the performance phase between musical origination and reception to be bypassed. Yet by and large most music is still intended to be performed at some stage of its passage from origination to reception. For the topic of creativity this means that origination and performance provide two different forums for the exercise of musical creativity.

Musical performance itself allows for two different forms of creativity. One pertains to the expressive rendering of musical structures (reviewed in Gabrielsson, 1999; Palmer, 1997; Timmers, 2002). The other involves the use of musical structures not specified in advance as part of a musical performance (so-called improvisation; see below). These performance-based forms of musical creativity can be thought of as real time, in that they are exercised in the course of an ongoing musical performance. They are integral to its temporal unfolding, adding nuance, expressiveness, and new structure, as the case may be. As such they engage a set of skills specific to performance, skills that draw on the facility for expressive mimesis that Merlin Donald has suggested sets humans apart from the other apes (Donald, 1993). They are musical members of what he calls “the executive suite” of a specifically human expressive intelligence (Donald, 1998), heavily engaged in the performance aspects of musical creativity.

Beyond the use of a variety of timing, modulatory and dynamic devices to shape performance expressively, many musical traditions provide opportunities or expectations for performers to elaborate the structural content of the music they play by embellishment or improvisation while performing (Nettl & Russell, 1998; Pressing, 1984). This freedom implies neither that performance is unconstrained nor that it necessarily is used for either self-expression or on-the-spot creation of musical novelty (Sutton, 1998). It need mean no more than that in these genres the musical prototype (referent, model) being performed does not specify all musically relevant parameters of performance, and that musicians accordingly are expected to supply specifics from their own resources as they go along. These resources typically

include a capacious store of learned musical materials and principles, including previous performances of the prototype by others as well as by themselves (Arom, 1990; Reck, 1983).

Modes of supplementing the prototype vary widely across musical cultures, genres and individuals (see Berliner, 1994; Chan, 1998; Gushee, 1998; Machlin, 2001; Powers, 1984; Racy, 1998; Slawek, 1998; Sutton, 1998; Viswanathan & Cormack, 1998). They span the gamut from mild embellishment to *de novo* creation, though the extent to which genuine on-the-spot novelty is created even in genres that prize it is a question as important as it is difficult to answer. Novelty has many possible levels of definition in a combinatorially rich and hierarchically structured domain like music (Lerdahl & Jackendoff, 1983; Merker, 2002). Empirical evidence bearing on the extent of musical novelty actually being created during musical improvisation is available in "alternate takes" of the same piece or solo from recording sessions of improvised music. Thus "alternate takes" of jazz solos from the same recording date tend to be similar, but even when substantial structural differences between "takes" are in evidence (see Machlin, 2001 for examples), this need not mean that the alternate structures employed were originated during the performance. Either version, or parts of either, may be a well-rehearsed pattern alternately chosen from a rich musical memory rather than originated *de novo* at the time of recording. Similar issues are in evidence in other improvisatory traditions (see, e.g., Reck, 1983; Sutton, 1998). Creativity in this sense would amount to skill in smoothly and innovatively combining or sequencing phrases or motifs from memory while conforming to structural constraints supplied by prototype and convention (such as chord progressions in jazz).

The question of the extent of actual novelty created in real time during musical improvisation is important not only for our understanding of the nature of musical creativity, but for exploring its biological background as well. Sequence variation and flexible recombination of phrases occurs in the calling or singing of some animals (see, e.g., Catchpole, 1976; Marler, 2000; Robinson, 1984; Ujhelyi, 1996). In some cases the resulting performances exhibit a degree of complexity and open-ended sequence structure sufficient to raise the question of what it would be called if performed by a human. The sedge warbler performs its repertoire of some 50 different song elements in sequences that essentially never repeat (Slater, 2000). The brown thrasher moves through its repertoire of some 1800 melodies while skipping melodies unpredictably. Nothing ever appears to repeat, except to a listener with an immense melodic memory functioning like a tape recorder (Catchpole & Slater, 1995, p. 167). Bengalese finches vary their non-deterministic song sequences endlessly in accordance with a finite state grammar (Okanoya, 2002), i.e., the least powerful (Type 3) level in Chomsky's classification of grammars (Chomsky, 1956). In groups of humpback whales, individual singing males make occasional and idiosyncratic innovations in their song pattern. These are copied by other members of the group (Payne, 2000).

The result is a cumulative turn-over of the entire repertoire of a group over some half dozen years, rendering each group of humpback whales a separate and changing song culture.

These examples not only raise the issue of animal improvisation and aesthetic creativity, but point to the evolutionary mechanisms that may account for such capacities. In all these cases the setting for the evolution of the capacity for complex and variable learned singing is sexual selection (Catchpole & Slater, 1995; Miller, 1997, 2000). This is the arena hosting the many other extravagant aesthetic displays of nature, such as the peacock's magnificent tail or the decorated bower of the bower bird (Darwin, 1871; Zahavi & Zahavi, 1997). It is therefore not far-fetched to ask whether our own propensity to sing and to dance, as well as our capacities for elaborating on the forms of doing so, might have a similar origin (Merker 2000, 2002, p. 14; Miller 2000; see also Todd, 2000). This is all the more likely since the concrete survival value of an expenditure of resources on music making is moot (Pinker, 1997). The human capacity for vocal learning, encompassing both song and speech, is one of the more conspicuous differences between us and other apes (Marler, 1970; Nottebohm, 1975, 1976; Janik & Slater, 1997). It is a prerequisite for both human song and speech in that it allows us to match vocal production to auditory percepts. This highly specialised capacity most likely arose in humans in the same way as it did in most other animals, namely on the spiralling paths of sexual selection. It is there, and nowhere else in nature, that one finds examples of complexity and inventiveness amounting to artistry. The issue of animal improvisation thus bears not only on central issues of human nature itself, but on the nature and the origin of the human practice of musical improvisation. To move this suggestion forward, it is human improvisation that needs further clarification at a level of rigour pioneered by studies of bird song.

We turn then to varieties of musical creativity that are not exercised in real time. Few of the considerations advanced above in relation to real-time performance need apply to the creative process of originating a piece of music through an act of composition. In principle the full score of a symphony might emerge in perfect silence, on paper alone, by fits and starts and constant revision, over a time-span of years. More typically, composition avails itself of performance at various stages of the process of finding, elaborating, varying, and selecting novel musical structures. A partial and tentative execution of a musical idea need not conform to the temporal demands of a coherent performance. This freedom from the primary constraint of real-time performance makes it a means and an aid to invention and elaboration. A musician who studies a prototype in preparation for a performance is faced with a process pointing in the reverse direction. Concerned with penetrating the intentions of the originator and discovering the full content of a piece of music (Berman, 2000; Dorian, 1942; Sundin, 1983, 1994), this process adds to that of composition a second variety of musical creativity occurring apart from real-time performance. This completes the above conception of

the varieties of musical creativity with a pleasing symmetry, as depicted in Figure 2.1.

Finally, it is worth reminding ourselves that most of the world's music has not originated through formal acts of composition – a mode heavily, though not exclusively, dependent on access to a system of musical notation. There are many informal sources of new musical structures in cultural processes featuring partial innovative change and its emulation in traditional settings (see, e.g., Shelemay & Jeffery 1993, 1994, 1997; Yung, 1997). Oral teaching and other, even less deliberate, forms of intergenerational transmission (Arom, 1990) are subject to variable fidelity as well as personal idiosyncrasy. Moreover, music is far more open to syncretism than is language (see Brown, Merker, & Wallin, 2000, p. 4), and this facilitates borrowing and assimilation between genres and musical cultures as a source of novel structures (see, e.g., Aparicio & Jaquez, 2003; Kaeppler & Love, 1998; Lomax, 1968; Nettl, 1978; Reynolds, 1998). The meaning and role of musical creativity at this level of diverse and changing musical traditions is a complex matter at the interface of ethnomusicology, cultural history and the sociology of music (Merker, 2002, pp. 11–12), decidedly beyond the scope of the present chapter. Even within the narrower scope of the preceding discussion, the examples alluded to should suffice to indicate that musical creativity is unlikely to be a unitary phenomenon. Music as a performing art provides opportunities to exercise creativity in composition, interpretation, expressive performance, and improvisation, as well as in allied fields such as the tuning of complex instruments (for which see Hood, 1998). The kind of talents and capacities promoting creativity in one of these areas need not be equally relevant to each of the others. By the same

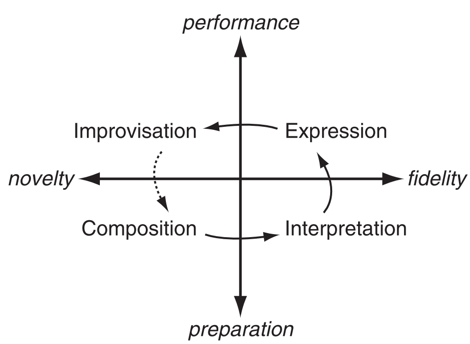

Figure 2.1 Schematic space of four major arenas of musical creativity, each with a privileged relation to two polar dimensions labelled "novelty–fidelity" and "performance–preparation". The latter is a convenient shorthand for the distinction drawn in the text between aspects of musical creativity that do and do not have real-time performance as their setting. The curved arrows are meant to suggest natural directions of transition between arenas, such as the necessity to interpret a composition in order to perform it.

token, this means that a flourishing musical genre or culture cannot dispense with any of them.

2.3 Are there musical constraints on musical creativity?

Beyond the diversity of creative arenas offered by music, are there any generic distinctions of music in relation to creativity? That is, might music itself harbour principles that help define its products – and thereby the creativity that gives rise to them – as specifically musical? An analogy from the domain of language may help clarify the nature of the question. A given language employs a limited set of some 40 phonemes to compose the vast stock of words that make up its vocabulary. These words, or, more strictly speaking, their constituent morphemes, in turn are used to compose the potentially infinite set of meaning-bearing sentences that may be generated with the help of the grammatical conventions of the language.

A creative speaker of a given language may on occasion violate the rules of its grammar to good creative effect, but linguistic creativity is generally exercised within the phonemic and grammatical constraints of a given language. It would be peculiar to claim that language imposes no constraints on linguistic creativity, or that creativity in the domain of language demands that we abandon grammar or dispense with the use of a constrained set of phonemes. There *are* forms of oral creativity that do so, exemplified by phenomena such as "speaking in tongues", but these are better regarded as extra-linguistic forms of oral creativity than linguistic ones. We have little difficulty making such judgements in the case of language, one reason being the already mentioned infinite potential for generating linguistic expressions inherent in the combinatorial powers of grammar. The conventions of language open up a limitless field for linguistic creativity on the basis of its very small set of phonological elements. Creativity in language therefore moves largely within those conventions rather than beyond them. Without them comprehensibility is compromised, and with that, the domain of language proper has been abandoned.

A similar argument can be made for the domain of musical creativity, once it is realised that music, like language, avails itself of a finite set of elements whose combinations provide a potentially infinite set of musical patterns (which, unlike the patterns of language, are not semanticised). In fact, music and language are intimately related at the deepest level of their generative principles in that both are founded on the "particulate principle of self-diversifying systems" (Abler, 1989; Merker, 2002). This abstract root principle of pattern generation was originally identified by William Abler (1989) as the ultimate generative principle behind the pattern diversity of chemistry, genetics, and human language. In brief, when members of a finite (usually small) set of discrete and non-blending elements, such as atoms, genes or phonemes, are combined they give rise to qualitatively new distinctive patterns that in turn can be combined, generating potentially infinite pattern

variety in the process. Abler called these systems *Humboldt systems* after Wilhelm von Humboldt's treatment of human language in these terms.

The essential principle of these systems is the discreteness and non-blending nature of the small set of elements they use for pattern generation. This is illustrated by the schematic contrast between a blending and a non-blending system in Figure 2.2.

Music was mentioned only in passing by Abler, but it provides a striking instantiation of such a system (Merker, 2002) because its pattern variety is based on a discretisation of the frequency/pitch continuum into musical notes forming "pitch sets" and, in all rhythmic or "measured" music (Arom, 1991, p. 179), on a pulse-based discretisation of the time continuum into sets of discrete durations with proportional values. This orthogonal discretisation of spectro-temporal space places a radical reduction of degrees of freedom at the very origin of the generative principles of music. That is, the first act of music, metaphorically speaking, is to throw away most of the continua of pitch and time, keeping only the skeleton of discrete notes and durations with which it creates its patterns. This allows music, like language, to achieve infinite pattern diversity by finite means, a circumstance of fundamental significance for our understanding of the nature of music. The topic has received a detailed treatment in Merker (2002), and the reader is referred to this source for the full background to the following remarks.

The identification of music as a Humboldt system is germane to the issue

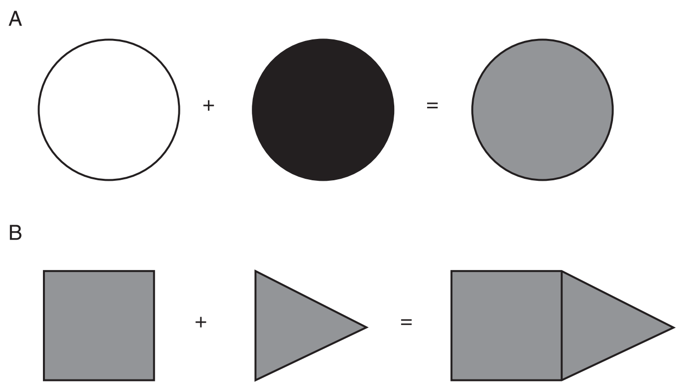

Figure 2.2 Schematic depiction of the contrast between a blending system and a non-blending, or particulate, system. In (A) a blending system is illustrated by, say, a body of clear liquid receiving a drop of black ink, resulting in a liquid with a grey tint. No amount of further mixing of ingredients or their mixtures will yield any qualitative novelty, but only quantitatively different shades of grey. By contrast, in (B) nonblending particulate entities are combined, resulting in qualitative novelty. Provided elements do not average their properties in combining, the further combination of the resulting pattern with either of the elements or with other resultant patterns produces a limitless variety of qualitatively distinct patterns. This is the principle of a Humboldt system. Based on a similar figure in Abler (1989).

of musical creativity in that the key to its infinite generativity is that very reduction of degrees of freedom that lies at the origin of its self-diversifying potential. It is by this radical reduction – by, for example, individuating the pitches called "C" and "C-sharp" from the infinitude of pitches that lie between and around them, and insisting on these as canonical in a given case[1] – that music conquers for itself the discrete, particulate nature of the elements whose combinations *then* open the door to the infinite universe of music as a Humboldt system. In these terms, infinite pattern numerosity as such is not the crucial mark of music: music would be dwarfed in this respect by the output of a multidimensional sound randomiser. Rather it is the feat of attaining to infinite pattern diversity on the basis of a finite set of elements that lends to music the distinction of being a Humboldt system. This is no mere matter of the prestige attendant on membership in an exclusive club: this same finitude of elements supplies a good part of the essential conditions for the discriminability, learnability, memorability and reproducibility of musical patterns, factors that have a profound influence on the emergence and survival of musical forms as cultural objects in cultural history.

In these terms, then, the question of whether there are musical constraints on musical creativity may be answered in the affirmative: music is music by virtue of the discretising constraints that provide it with limitless scope for creating qualitative novelty by self-diversification through the operation of the particulate principle. With that it becomes possible to make useful categorical distinctions among the various forms of creativity that make use of the possibilities of spectro-temporal space. We have already mentioned speech, which does so on the basis of its small sets of phonemic articulatory gestures and, like music, does so on the basis of the particulate principle. But human creative ingenuity is not limited to exercises in particulate combinatorics: it is possible to work creatively in the medium of sound directly, without the initial reduction of degrees of freedom that makes music a particulate system. The possibilities of such creativity have been drastically enhanced by modern electronic means for storing and modifying sound, and have been under active exploration by artists with a wide range of orientations and techniques for the better part of a century. To the extent that such efforts dispense with the discretising principle that defines music as a Humboldt system, they place themselves in a new category of spectro-temporal pattern creation, and it might be useful to recognise this distinction by a corresponding terminological one. Since some of the artists exploring this domain have started referring to their discipline as "soundart" (*Klangkunst* in German), this would provide a most appropriate term from the present perspective. According to this convention, music and soundart would be nested within the larger compass of the human creative arts, as illustrated in Figure 2.3.

It is to be noted, finally, that the particulate principle can help define only the universe of pattern possibilities within which the realised patterns of extant musical forms develop, and not their closer determination in any given musical genre or tradition in cultural history. It thus supplies a highly abstract

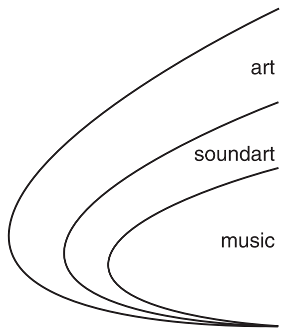

Figure 2.3 Open Venn diagram illustrating the nested relationship between music, other arts that employ sound as their medium, and human arts more generally.

constraint on musical creativity. On the one hand this means that it does not dictate the nature of the patterns that are created by its means, and on the other it means that it gives the creative musician very little guidance regarding pattern specifics in the creative process (see section 2.5). It simply points to the nature of the raw materials with the help of which the creative imagination may exercise its powers in the domain of music. Given those raw materials, a natural task and goal of musical creativity as such would be to explore the universe of their combinations according to the aesthetic criterion of "sounding good" (rather than according to their efficacy in achieving a variety of other conceivable effects on the human mind). This appears to be what Hanslick had in mind in propounding his much discussed views on aesthetics in music (Hanslick, 1854). Needless to say, the particulate principle itself is too general to bear directly on what "sounds good". It does, nevertheless, bear on an allied issue: the overwhelming tendency of the human musical imagination, across millennia and a great diversity of cultures, to produce music whose elements in the pitch domain relate to a reference pitch or "tonal centre" – so-called tonal music (Jackendoff, 2000; Lerdahl & Jackendoff, 1983; Mache, 2000, p. 475). As we shall see, this tendency is most intimately entwined with the particulate basis of musical pattern formation.

2.4 Tonality as a constraint on musical creativity

To the extent that tonality is regarded as a culturally based convention, it need have no bearing on issues of musical creativity. Yet the cross-cultural ubiquity of tonal music, and the ability of listeners to perceive tonality in music employing unfamiliar scale systems (Krumhansl, 1990), hints that it may have a deeper significance in the world of human music. There are now indications that this is so, and that it involves quite general and basic issues of how the auditory system arrives at the perception of tone sequences as patterned wholes or melodies. These indications come from a series

of well-controlled and demanding experiments performed by Wright and colleagues on the tone perception of macaque monkeys (Wright, Rivera, Hulse, Shyan, & Neiworth, 2000). The animals were trained to give "same" or "different" judgements in response to tone sequences.[2] As expected, macaques judged original and transposed versions of sequences of single repeated tones to be more and more dissimilar with increasing pitch distance. Transposing a repeated tone six, twelve, eighteen and twenty-four semitones (half, one, one and a half and two octaves) monotonically increased dissimilarity judgements. In sharp contrast to this result obtained with repeated single tones, macaque judgements of the similarity of melodies showed full octave generalisation, *provided* these melodies were simple tonal melodies rather than atonal ones.

That is, macaques, like humans, treated a *six* semitone transposition as *less* similar to the original than a *twelve* semitone transposition when the melody was the kind of simple, tonal, memorable pattern common in folk music and children's songs, but not when it consisted of otherwise matched atonal melodies. By the standard of their "same" judgements for pairs of identical *natural sounds*, the macaques actually judged one and two octave transpositions of (humanly) memorable tonal tunes to be identical to the original. When judging single tone and atonal melodies macaques appeared to adopt a same–different criterion based on "physical" stimulus characteristics, whereas they judged tonal melodies by a different standard, presumably akin to human "Gestalt"-based perception of the same patterns. In an attempt to elucidate this difference, Wright and colleagues applied Takeuchi's maximum key profile correlation measure of tonality to the macaque judgements. This measure is based on *human* tonality judgements (Krumhansl & Kessler, 1982; Takeuchi, 1994). It accounted for 94 per cent of the variance in the monkey results. This remarkable finding indicates that macaques have a perception of tonality very similar if not identical to that of humans.

The significance of these findings lies in the fact that macaques are decidedly *nonmusical* primates: they do not sing like the gibbons do (Geissmann, 2000; Hauser, 2000). Nothing remotely resembling even the simplest musical structure plays any role in their behaviour, vocal or otherwise. We are thus confronted with the strong possibility that it is that which the macaque auditory system shares with the human auditory system – and therefore plausibly with that of higher primates generally and even all higher mammals – rather than anything specifically musical or cultural, that accounts for the similarity of tonal judgements and Gestalt perception of melodies in the two species.

It appears, in other words, that the sense of hearing itself, in its higher reaches, uses the simple fact of tonality, that is, the fact that constituent tones of a sequence are implicitly related to a stable reference pitch or "tonal centre," as a strong criterion for treating such a sequence as a perceptual whole or Gestalt, that is, as the coherent and distinctive pattern we call a *melody*. In purely pitch sequence terms it would be this fact that defines

higher order entities in the combinatorics of discrete pitches, conferring recognisable identities of their own on the new entities created by combining and recombining simpler entities in particulate fashion. But this is the essential condition for fulfilling the nonblending requirement of a Humboldt system (Merker, 2002, p. 8). That is, each new combination of elements must form a distinctive and recognisable whole – in this case a perceptual one – resulting in an entity that in its turn can be combined with others to form further unique entities. While music is far more than pitch sequence, the fundamental importance of tonality as a basis for grouping tones into melodies thus makes this a central device of music as a Humboldt system, conferring on tonality a role in music partially analogous to that of syntactic well-formedness in language. From the macaque results it would appear that this central device is given to us not by music itself but by inherent properties of the auditory system that we share with species devoid of musical behaviour of any kind. As Wright *et al.* (2000) point out, sensitivity to tonal hierarchies is a rather sophisticated musical ability. To find that it might reflect directly the mode of functioning of the higher reaches of the very sense of hearing independently of a species' possession of music opens unexpected perspectives on the conditions under which musical creativity is exercised.

These findings, along with those on physiological factors in the perception of consonance and dissonance (Plomp & Levelt, 1965; Roederer, 1995; Sethares, 1998; see also Bell, 2002; Braun, 2000; Kwak & Kendall, 2002), suggest that functional characteristics of the sense of hearing penetrate deep into a perceptual terrain that some would regard as a privileged domain of specifically human musicality and musical acculturation. It would seem, rather, that auditory space is not a blank slate awaiting with neutrality the imprint of *whatever* a musical creator or tradition chooses to engrave upon it. If not just musical acculturation but the very apparatus of hearing singles out tonal melodies from atonal ones, and treats them as distinct entities with consequences for musical cognition and memory, then musical creativity is not exercised on a smooth and level playing field as far as musical structure is concerned. Instead it takes place in a complex landscape whose contours are significantly shaped *in musically relevant ways* by the inherent properties of our sense of hearing. Additional examples underscoring this conclusion can be found in the domain of auditory scene analysis (Bregman, 1990).

That is, in a search for factors affecting the exercise of musical creativity there is reason to go beyond the musical culture in which the creator has grown up, to consider the even more fundamental and universal influence of musically relevant biases and predispositions supplied by our sense of hearing itself as a significant influence on human responsiveness to the products of musical creativity. Since this influence is bound to propagate in multiple ways and through many interacting channels throughout the cultural history of music, here would seem to be a fruitful source of insight into major aspects of the structural contents of musical traditions cross-culturally, as well as into the cultural history of music within given musical traditions. Assuming

that the findings of Wright and colleagues on the melodic perception of macaques will stand the test of time, these would seem to be issues which anyone who takes musical creativity seriously either as a calling or as a topic of research ignores at their peril.

2.5 Conclusion: Cultural contingency as enabling condition

An infinite variety of musical forms are realisable in the multiple arenas of music as a performing art through particulate combinatorics utilising a tonal criterion of melodic entities. This infinity, by and large, defines the pattern space within which given musical cultures, traditions, genres, and contexts have worked out their specific contributions to human music. So vast is that space that even the collective sum total of all the musical patterns created by the many human musical cultures and genres over historical time provide only a sample of its potential contents. In gradually exploring that space in accordance with the self-diversifying dynamics of a particulate system, these cultures and genres have invariably been under historically contingent constraints of their own. That is, to the general constraints discussed in the foregoing they have added their own historical and genre-based boundary conditions to the exercise of musical creativity. This may be the inevitable price they pay for their participation in the self-diversifying spectacle of music as a Humboldt system. So diverse are its pattern possibilities that free creation in its space only rarely would produce a pattern related in any determinable way to another such unconstrained creation. Yet relationships between patterns are the essence of what it means to understand and recognise them, and, in the end, to appreciate them.

This, again, is only another consequence of the workings of the psychological apparatus through which music is apprehended. To listen to a sequence of music *appreciatively* requires a background of familiarity with at least vaguely related materials on the basis of which the structure as well as distinctions of the present sequence are apprehended, recognised, and known. Such familiarity can only be acquired through a listening history. To be stocked with *related* patterns such a listening history must be informed by the contents of a genre or tradition, constraining itself to a historically contingent subspace of the total pattern space available. Layered constraints on musical creativity, all the way down to historically and culturally contingent ones, are thus a necessary condition for musical appreciation as such, an appreciation that in turn supports the tradition on which it feeds by providing it with an *audience*. The latter is the population whose musical sensibilities have been shaped by the coherent listening history made possible by exposure to a given musical tradition. Only one aspect of this appreciation is the novelty whose absence leads to boredom but whose excess is confusing (Sachs, 1967). Musical creativity thus occupies the crest of a historical travelling wave of gradual change and diversification of musical patterns for which the substance of tradition provides the moving mass and for which the innovative musical

imagination supplies impulses for directional change. Without either, music as we know it would hardly exist.

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Notes

1 This discretisation of the pitch continuum into "pitch sets" occasions the need for an ability specific to music, namely the ability to adhere to the pitch locations designated by a pitch standard during performance (intonation). Not to do so is to sing or play "out of tune", while to do so with precision is a distinguishing mark of musicianship everywhere. The corresponding perceptual ability constitutes the "musical ear". Both, of course, are connected to the topic of musical creativity, at least in its performance aspects.

2 Extensive training is required to get monkeys to perform reliably in experimental situations. Auditory tasks present special difficulties in this regard, but these were successfully solved in the Wright *et al.* study. The means for doing so included presenting sample sounds from a central loudspeaker, while comparison sounds were delivered through flanking loudspeakers that the animals touched to indicate their judgements. Through a process of gradual shaping the animals were taught the abstract concepts "same" and "different" with the help of a large number of natural sounds from a sound-effects library to the point where they produced accurate judgements of any novel sound pair. This not only provided a well-documented performance criterion before the introduction of musical stimuli, but ensured that decisions were based on relationships rather than absolute stimulus properties. This in turn was a crucial prerequisite for any chance of finding octave generalisation. Moreover, only a few music trials were presented in each session and fewer still of octave generalisation, and these stimuli were also made diverse in their properties in order to prevent the monkeys from memorising specifics about the elements making up the melodies. These various features of the experimental design all militated against the monkeys developing expectations regarding the stimuli and making item-specific judgements (e.g. based on pitch alone). These lengthy and exacting procedures allowed the experimenters to reveal the relational basis of macaque judgements of tone sequences. The interested reader is referred to the original publication for further details.

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3 Musical creativity between symbolic modelling and perceptual constraints

The role of adaptive behaviour and epistemic autonomy

Mark M. Reybrouck

3.1 Introduction

This chapter addresses the concept of musical creativity. Rather than giving an overview of established views on the subject, it aims to introduce a theoretical framework that should provide an operational description of creativity by approaching it from the positions of cybernetics and systems theory (see Reybrouck, 2005). As such it should go beyond approaches that conceive of the process of creativity only at the level of composing and performance, and that focus mainly on a rather limited range of music. The approach I propose locates musical creativity both at the level of the reception and performance of music, and at the level of internal processing. As such it allows us to conceive of musical creativity in terms of interaction, as "coping with the sonic world".

In order to do this I argue for the introduction of an operational terminology that describes the basic functions of dealing with music and that has explanatory power as well. Basic to this approach are the conception of musical creativity as an adaptive process of "knowledge acquisition", and the possibility of carrying out "symbolic operations" on the acquired elements.

Several questions should be raised here:

(1) How do we deal with music? Is it something "out there", allowing us to conceive of music in "objectivist" terms without any reference to the *music user*, or does it call forth interactions with the sound, stressing the role of the music user as well?
(2) What kinds of interactions are at work in dealing with music? Do we interact with "actual" sounding material, immediately present as in listening and performing, or do we deal with music at an internalised, virtual level, relying on memory and imagery?
(3) What is the mechanism of sense-making in dealing with music? Do we rely on continuous processing of acoustic information – as a kind of servomechanism – or can we distance ourselves with respect to the perceptual flux and deal with music in a kind of symbolic play?
(4) What is the role of creativity in this process of dealing with music?

These questions are related to the pragmatic claims of Dewey (1958, p. 48), who characterised experience as an interplay between doing and undergoing:

> In short, art, in its form, unites the very same relation of doing and undergoing, outgoing and incoming energy, that makes an experience to be an experience . . . The doing or making is artistic when the perceived result is of such a nature that its qualities as perceived have controlled the question of production . . . The artist embodies in himself the attitude of the perceiver while he works.

3.2 The epistemic control system as a starting point

Dealing with music is a process that goes beyond the particularities of musical behaviours such as listening, composing, or performing. It is a general term that allows us to conceive of music in terms of *coping* with the sonic world (Reybrouck, 2001a, 2005), and to conceive of music users as *devices* interacting with the external world. Such devices function as informationally open systems with sensory inputs, motor outputs, and co-ordination between them to form simple "perception–cognition–action loops" (Cariani, 1989). As such they are related to the *epistemic control system*, which draws a distinction between input, output, central processing, and feedback (Figure 3.1).

The epistemic control system is an old and much used concept that embraces the major moments of cybernetic functioning. It allows us to conceive of the music user as an *adaptive device* going beyond the linear stimulus–reaction chain, and instead generating a cycle that functions as a closed loop. As such it invokes the concept of *circularity*, feeding the output back to the input, and allowing the music user to evaluate and control their output through the flexible coordination of perception and action.

The basic idea behind this concept is *conservative behaviour*, with the "servomechanism" as a prototypical example (Berthoz, 1996; Paillard, 1994). This means that the music user is in continuous interaction with their environment in an attempt to keep any disturbances within critical limits. Such conservative behaviour is obvious in many musical applications: to mention just four, the traditional pedagogy of instrumental teaching involving a

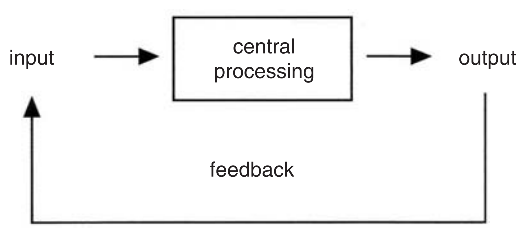

Figure 3.1 The basic schema of a control system.

teacher–apprentice relationship, where the apprentice tries to imitate the teacher's playing; the act of playing music from a score; the act of improvising; and the act of composing.

Common to these "musical behaviours" is the process of sensory–motor integration, with a gradual shift from presentational immediacy (acoustic information is presented to the senses) to symbolic representation (there is no sensory input). Playing a musical instrument is a typical example of motor output, which becomes a behavioural response to perceptual input as soon as there is a modification or adjustment of the sound production as a result of feedback through the senses. What is at issue here is the possibility of comparing actual sounds with a kind of target performance, which is either actually present (as in imitation) or present in imagination (as in aural training and silent reading). The same holds true for the act of improvising, in which the sounding result is constrained by some kind of schematic representation in the music user's mind. The whole process yields a sounding product – unlike the case of composing, where the actual performance can be totally disconnected from the conception in the composer's mind. At an "ideational" level, however, there is still an input–output mapping, albeit at the virtual level of mental simulation.

This distinction is important. It revolves around the construction of an *internal model*, which allows the music user to go beyond the constraints of perceptual bonding and to carry out mental operations on virtual elements. The presence or absence of sensory input or output is the critical factor here, involving a transition from *sensory–motor coordination* to *simulation*, with the latter relying on representation rather than on sounding material. The brain, then, no longer operates as a "controller" reacting to sensory stimulation, but as a "simulator" that carries out internal operations on mental replicas of the sound (Berthoz, 1996, 1997; Paillard, 1990, 1994). As such we can conceive of music users as devices with an internal model of the environment (Berthoz, 1997; Klaus, 1972). This is an interesting claim that has been developed in the domains of cybernetics, robotics (Cariani, 1989, 1998a, 1998b; Ziemke & Sharkey, 2001) and biosemiotics (Emmeche, 2001; Meystel, 1998; von Uexküll, 1957), and that stresses the role of the central processing of the control system: it allows us to deal with music in terms of internal simulation and symbolic play, which is, in fact, a game theoretical approach.

The game theoretical approach echoes the older concept of an *epistemic rule system* (Klaus, 1972), with the epistemic generalisations of "homo sapiens", "homo faber" and "homo ludens" and their translation in terms of automata. As such we can substitute a "perception machine" for homo sapiens, an "effector machine" for homo faber, and a "playing automaton" for homo ludens (Figure 3.2). Each of these automata, moreover, can be considered as effecting a specific function, which can be modified up to a certain degree, allowing us to conceive of the music user as an *adaptive device*.

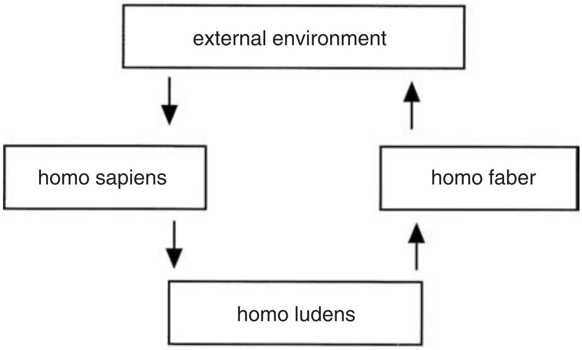

Figure 3.2 The epistemic rule system (after Klaus, 1972).

3.3 The music user as an adaptive device

Dealing with music is a process of coping with the sonic world, whether at the level of actual sounding or at the level of imagery. It entails a constructive process of sense-making that matches the perceptual input against a knowledge base and coordinates it with possible behavioural responses. This is the standard theory of cybernetic functioning, which can be easily translated to the realm of music. The music user, in this view, can be considered as a device made up of sensors, coordinative computations (input/output mappings) and effectors, somewhat analogous to the primitive functions of *measurement, computation* and *control* (Cariani, 1989, see Figure 3.3a). These functions can be considered in terms of their organismic counterparts, such as *perceptions, actions*, and flexible *perception–action coordinations*, and each of them can be a locus for adaptation. Contemporary conceptions of learning devices have focused mostly on the coordinative, cognitive adaptation located in the computational part of the rule system, allowing us to conceive of the music user as a *formal-computational device*.

The idea is appealing and is not uncommon in post-war music theory, which deals mostly with sets of elements that can be handled in a symbolic way (a representative example is Forte, 1973). It is possible, however, to broaden the computational approach and to consider the functions of perception and action as well. But before doing this I will elaborate on the concepts of *computation* and *artificial devices* in an attempt to apply them to the realm of music.

Computations are considered mainly from a *symbol-processing* point of view. The basic idea behind this approach is formal symbol manipulation by axiomatic rules, with a complete conceptual separation between the symbols and their physical embodiment. It finds an implementation in computer programs that handle "discrete symbols" and "discrete steps" by rewriting them to and from memory to a sequence of rules (Pattee, 1995). There is, however,

a broader conception of computation, which considers the input/output couplings that can be handled in terms of "modelling" or "predictive computations" (Bel & Vecchione, 1993) and entails the basic idea of the "homo ludens" as a playing automaton. Computation, on this broader view, embraces the whole field of mental operations that can be performed on symbolic representations of the sound.

Artificial devices are formal-computational devices, to the extent that they have no potential for adaptation in relation to perception and action. As such, they are limited in their semantic relations with the (sonic) world as they rely on a restricted and fixed set of elements and operations. It is possible, however, to conceive of artificial devices as "adaptive devices" – devices that can adapt themselves through epistemic transactions with the external world.

This is a critical distinction, because it allows us to conceive of different kinds of artificial devices. According to Cariani (1991) there are basically three kinds (Figure 3.3):

(1) A *formal-computational* or *non-adaptive* device operates completely within the symbolic realm and is completely independent of its environment; it does not alter its structure on the basis of its experience and can be described only in terms of computations, lacking all kinds of real world (external) semantics (Figure 3.3a).
(2) An *adaptive computational device* alters the input–output algorithm of its computational part on the basis of its performance, but is constrained by the fixed, non-adaptive nature of its sensors and effectors (Figure 3.3b).
(3) *Structurally adaptive devices* construct new material structures and can evolve new semantic categories through the adaptive construction of sensors and effectors (Figure 3.3c).

The concept of an adaptive device is very fruitful. It has descriptive and explanatory power and can be applied very easily to music users, who can learn to make new distinctions – expanding their set of observables – and to carry out new computations on them. Let us, for example, consider a composer who takes advantage of stereotyped combinations to generate music of an essentially non-creative nature – somewhat similar to the musical dice games popular in the eighteenth century (Kirnberger, Mozart, etc.). What he or she is doing is carrying out mental operations on a set of discrete elements. There is a set of pitches, ranging over seven octaves, a limited set of durations, a finite set of instruments, some dynamic indications and some rules of voice leading and harmony. The composer can listen to or perform the music, but this does not alter the elements and the rules of combination. There is a fixed lexicon (the elements) and a set of syntactic rules that are not altered by the act of composing. Such a composer can be considered as a formal-computational device.

The situation is different, however, if the composer is trying out new elements and combinations through exploratory listening and performing,

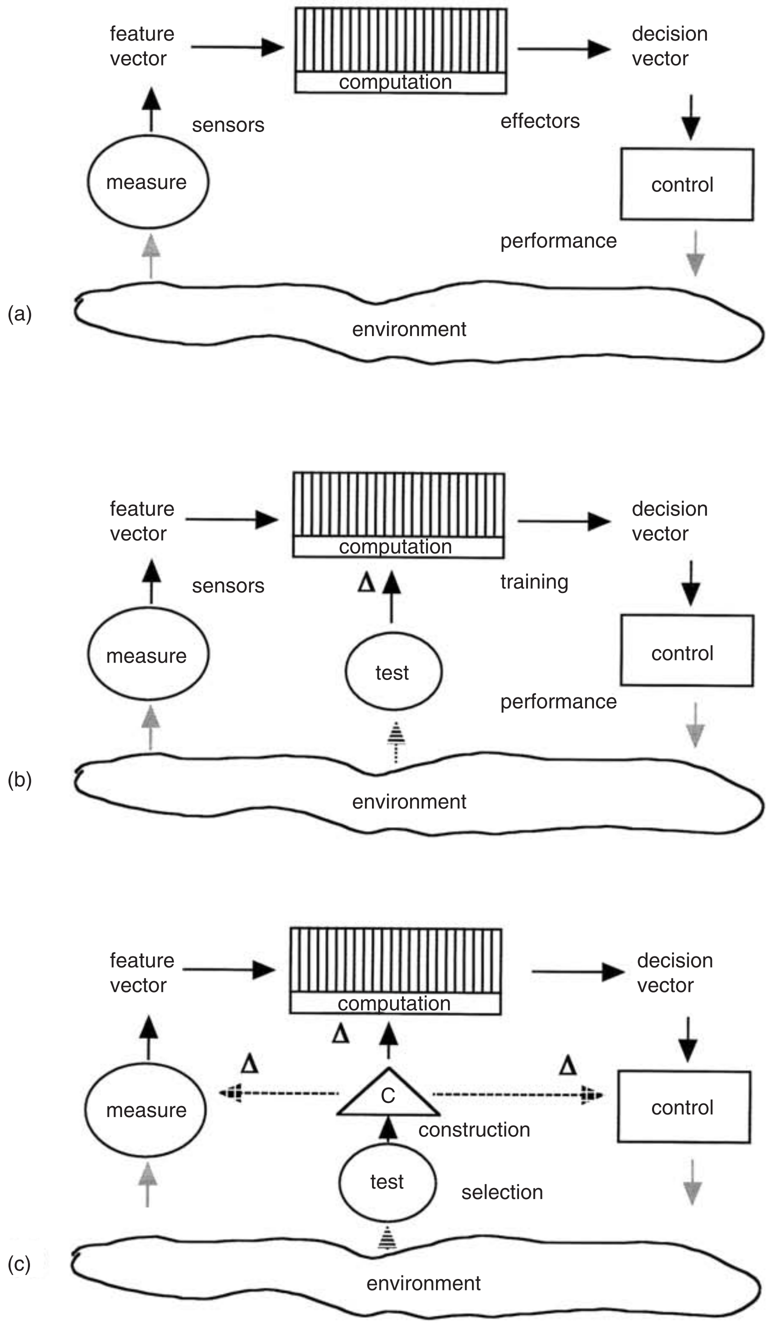

Figure 3.3 Three kinds of artificial devices: (a) a formal-computational or nonadaptive device is able to perform input-output coordinations and computations without altering its structure, (b) an adaptive computational device can alter its computational part, and (c) a structurally adaptive device can alter its sensors and effectors (after Cariani, 1989, 1991, with permission).

allowing him or her to change the syntax and semantics. In this way the sound experiments of Debussy, Ravel, Messiaen and Stockhausen are distinct from stereotyped combinatorialism: they are exploring new sounds or combinations of sounds and new rules of combination, and as such we can conceive of them as *adaptive computational devices*. The situation, however, becomes more complicated as soon as robots and computers replace the human ear and motor interfaces. Computers are able to make distinctions that go beyond the constraints of perception, and the same holds true for their performance abilities. We now have at our disposal tools for new kinds and more objective forms of listening (spectrographic listening, navigation tools for sonic browsing; see Aigrain, 1999), for computer-aided composition, and for performing. As such we can conceive of *structurally adaptive devices* that are able to modify their sensors and effectors and that are implemented in computer technology.

These claims are challenging. They raise the issue of *epistemic autonomy*, in that devices can arbitrarily choose what kinds of distinctions are to be made (perceptual categories, features, and primitives), what kinds of actions are performed on the environment (primitive action categories), and what kinds of coordinative mappings are carried out between the two sets. To quote Cariani (2001b, p. 60):

> adaptive systems . . . continually modify their internal structure in response to experience. To the extent that an adaptive epistemic system constructs itself and determines the nature of its own informational transactions with its environs, that system achieves a degree of epistemic autonomy relative to its surrounds.

The musical applications of this approach are numerous. They are exemplified in the distinctions made by composers of the twentieth century in their search for new sounds and timbres (Russolo, Varèse, and many others). Influences such as "musique concrète" and electronic and electroacoustic music have renewed and challenged the basic principles of Western music through stressing the role of sonority and timbre. And the role of the computer as an aid in composition has amplified the possibilities of making new distinctions and even manipulations of sound as well. There is a new science today that embraces the technology of both production and control of sound. Music theory, conceived in this light, relies on sensors instead of receptors, substituting tools for organs and introducing several kinds of machinery that can generate, transform, and control many kinds of movements and sound production (Dufourt, 2001). Musical instruments, too, have been transformed into automata that receive, transduce and analyse information.

But the concept of adaptive devices also applies to our dealings with music of the "common practice" tradition. As an example, consider the experience of a nineteenth-century adagio. What the listener hears is in essence a succession of sounds and sound configurations located in a time series and

apparently selected from a virtual infinity of possibilities. Very often the listener does not know in advance where the sound events are going to: this is a kind of listening "in suspense" that is typical of Romantic music with its many modulations, digressions and developments. It cannot be stressed sufficiently that this music must be listened to in order to make sense, and this basically applies to all music. The multiple revisions of the symphonic music of Bruckner and Mahler illustrate the role of feedback through listening in shaping the final work. But it should be noted also that the vast majority of composers have always worked empirically at their instruments or at least alternating between instruments and desk. Eighteenth-century (and earlier) composers were without exception performers, and usually notable improvisers as well. It is only in the nineteenth and twentieth centuries that we begin to have composers who were not performers.

All these claims have consequences for the process of dealing with music. There is, in fact, a tension between, on the one hand, *modelling* and *simulation* – which take place at a virtual level of dealing with the music – and on the other the *actual experience* of music as it sounds. The former can proceed autonomously and out of time, whereas the latter proceeds in real time and is constrained, because there are limitations as to what the listeners can distinguish. As such there can be a mismatch between what composers believe to be meaningful and what listeners actually hear and process. The same holds true for computer-aided composition, which has the potential to transcend traditional limits of perception and performance. The crux of the matter, however, is the possibility of changing relations with the external world: it is this that allows us to conceive of the music user as an adaptive device capable of changing its sensors, effectors and computations.

3.4 Adaptive behaviour and the concept of creativity

Adaptation is a process that changes an organism in order for it to survive in its environment (Fleagle, 1999). It is a biological concept that can be translated to the realm of cognition, as stressed by Piaget (1967). It has proven to be fruitful for educational theory and pedagogical practice in general, but can also be applied to music theory (Hargreaves, 1986; Imberty, 1996; Papoušek, 1996; Reybrouck, 2001a). Central to this approach is the concept of *equilibration* as a mechanism that enables the organism to achieve a state of equilibrium, both within its cognitive structures and between these structures and the environment. These structures are seen as "unstable" in relation to new objects and experiences, and the tendency to equilibrate towards more stable states is a kind of intrinsic "cognitive drive" that motivates exploration (Hargreaves, 1986, p. 33). As such, the environment provides a constant source of feedback, which guides the tendency to explore and to reach levels of stabilisation as the result of adaptation by the processes of *assimilation* and *accommodation*.

The main idea is quite simple and is exemplified in Figure 3.4. Equating the

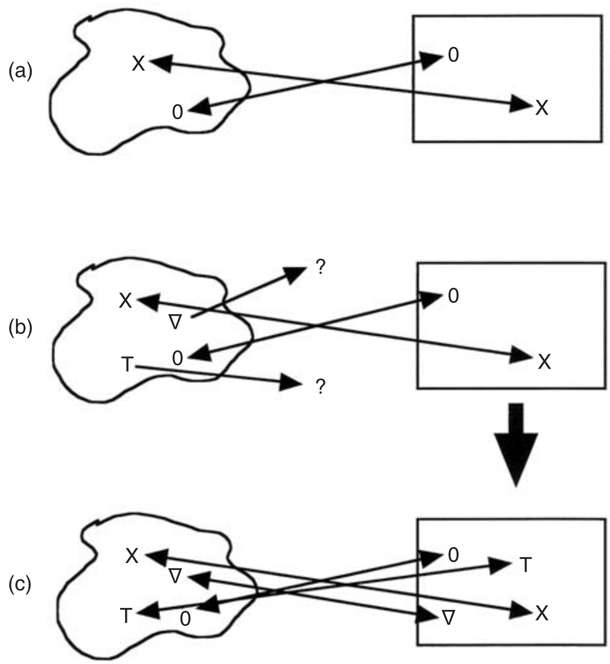

Figure 3.4 Assimilation and accommodation: matching between the elements of the music (left) and the cognitive representation in the mind (right). If there are as many elements in the music as in the mind (a), there is assimilation. If there are more elements in the music than in the mind (b) the music user must accommodate, in order to provide a new matching and to achieve a new state of equilibrium (c).

left side of the figure with the elements of the music, and the right side with the cognitive representations in the music user's mind, we can consider several mappings between them. If there is a perfect matching (one-to-one relationship) we can conceive of this as *assimilation* (Figure 3.4a): the music user has the representations already installed in their mind. If, however, there are more elements in the music than there are representations in the music user's mind (Figure 3.4b), there is a matching problem that must be solved by a process of *accommodation*: the music user must create new representations (Figure 3.4c), but once these are installed, there is a perfect matching again. The music user, then, has adapted themself and has achieved a new state of equilibrium.

There are many musical illustrations of these claims. Consider for example the music of the modernist tradition, which was at times problematic for the audience of the time. The classical example is Schoenberg, whose serialism illustrates the non-coordination between "experienced" and "conceived structure", or, put in other terms, between "composing" and "listening

grammars" (see Lerdahl, 1988). Many other examples could be given that illustrate the tension between music as an intelligible structure and the listener's capacities for making sense of it. Listeners, as a rule, should be able to coordinate the structure of the music with their cognitive structures. If this is not possible, there is a matching problem, which may invite them to accommodate in order to provide a new kind of mapping.

The Piagetian concept of *equilibration* is very useful here. It has profoundly influenced the *constructivist* approach to knowledge acquisition in general (Gardner, 1991; von Glasersfeld, 1995) and is likely to be of interest for the process of dealing with music as well. The roots of this approach can be traced back to Piaget and Dewey and place emphasis on creativity and motivation for learning through activity. Basic to this conception is the idea that knowledge must be constructed through interaction with the environment: this stresses the role of the subject who is doing the cognising, rather than conceiving of objects of cognition that are "out there". As such it is closely related to the "non-objectivist" and "enactive" approach to cognition (Johnson, 1987; Lakoff, 1987; and, for a musical analogy, Reybrouck, 2001a, 2001b).

The idea of knowledge construction is very appealing. It allows us to conceive of musical creativity not only in computational terms but also in terms of "knowledge acquisition". It locates creativity also at the epistemic levels of musical input and output, somewhat concealing the interface between these levels. Musical input is classically seen as the subjection of acquired knowledge and perceptions to computation and modelling. Musical output – and here is the essential point – is not merely dependent on the computational process, but is closely involved in it, so that computation passes over from the adaptive processing of music into the production of new music.

We should take these claims seriously. They allow us to conceive of the music user as a learning and adaptive device coping with the sonic world: in doing so he or she can make new distinctions between the observables (perceptual primitives), carry out internal computations on them, and even act on them. This allows us, for short, to modify our semantic relations with the sonic world. According to Cariani (1991, 1998a, 2001a) there are three basic mechanisms for doing this: it is possible (1) to amplify the possibilities of participatory observation by expanding our perceptual and behavioural repertoire; (2) to adaptively construct sensory and effector tools; and (3) to change our *cognitive tools* as well.

The musical analogies are obvious. As to the first mechanism, we should stress the importance of listening to a wide range of music. This can be helpful for the creative music user to gain familiarity with measurable parameters such as pitch, timbre, duration, and intensity and to broaden their perceptual categories. Different music cultures rely on different tone scales and divisions of the pitch continuum, and the same holds true for metrical-rhythmical groupings and divisions of time. But most striking is the richness of instrumental sounds that provide an infinite variety of possible distinctions

within the sonic world. In addition, there are highly interesting contributions from the search for new colours and the modifications and modulations of sound that are so typical of the past century's music. There is a large body of work in which composers have focused on the synthesis and elaboration of sound material (amplitudinal variation of attack, sustain and decay, variation of density, control of elementary parameters, and frequency–energy relationships of the spectral components) (see Deliège, 2001; Dufourt, 2001): composers such as Messiaen, Boulez, Stockhausen, Ligeti, Xenakis, Berio, Nono, and Carter illustrate the point, but we can conceive of contemporary music in general as a laboratory both for exploring the possibilities of natural sounding events and for the conception and realisation of new, non-natural sounds. It is up to the music user, then, to decide which distinctions will be made and to enhance the grip on the observables by choosing, selecting and delimiting some of them and raising them to the status of things that can be denoted deliberately (see also Reybrouck, 1999, 2003, 2004). As such the music user can expand their *perceptual repertoire*.

As to the second mechanism, we should conceive of the music user as an adaptive device able to modify or augment its sensors and to perform active measurements as a process of acting on the world and sensing how the world behaves as a result of these actions. The modification of its sensors allows the device to choose its own perceptual categories and control the types of empirical information it can access. Several strategies are available for doing this, but the basic mechanisms are reducible to two processes: altering existing sensing functions and adding new ones. This can be illustrated by means of technological tools for musical signal analysis and sound processing, but the modification of the effectors is equally important here, and is best illustrated through the evolution of musical instruments that go beyond a one-to-one mapping between the movements of the performer and the sounding result. This causal relationship is abandoned in computer music performance and the new generation of "logical" acoustic instruments, where controllers based on different kinds of sensors take over the continuous control of sound characteristics. The mapping, then, becomes a creative tool of performance and composition.

It is possible, finally, to change the cognitive tools as well, with or without modifying the sensory or effector tools. Here the role of cognitive mediation comes in, allowing the music user to perform symbolic operations on the mental replicas of the sound (Reybrouck, 2005). It is this that most closely approximates to the common view of musical creativity.

3.5 The concept of creativity: From an intuitive to an operational approach

The concept of creativity is a very topical issue in music theory. It is related to creative production, problem solving and divergent thinking in general, but it is quite difficult to put it in an operational format. Many definitions are

intuitive rather than formal and operational, and most of them deal almost exclusively with the computational level of the control system. A typical example is the distinction that the old Sanskrit scholars drew between the four stages in the articulation of thought: at first there is an empty space with undefined elements of thoughts, then comes the grasping of the thoughts at a preverbal level, followed by the formulation of words at a mental level, with as a final stage the explication of thought through articulate sounds (Daniélou, 1967).

This intuitive approach has been remoulded several times. An example is the famous distinction which Wallas (1945; see Webster, 1990, 1992 for a musical analogy) drew between the four steps of *creative thinking* or *production*: preparation (information is gathered), incubation (work proceeds unconsciously and information is allowed to simmer or ripen), illumination ("inspired" solutions emerge), and verification (solutions are tested and elaborated). An analogous but more detailed description was proposed by Rossman (1931), who studied more than 700 reputable inventors and distinguished seven steps: a need or difficulty is observed, a problem is formulated, the available information is surveyed, solutions are formulated, the solutions are critically examined, new ideas are formulated, and the new ideas are tested and accepted.

These findings are interesting. They illustrate the connections between elements of creative thinking and problem solving suggested by Dewey (1933), who distinguished five steps in problem solving: a difficulty is felt, the difficulty is located and then defined, possible solutions are suggested, consequences of these solutions are considered, and a solution is accepted, others having been rejected. The idea of problem solving has also been extensively elaborated by Guilford, who related it to adaptive behaviour (Guilford, 1979, p. 113):

> It is recognized that there is a problem-solving activity whenever an individual encounters a situation for which he has no adequate response ready to function among his repertoire of reactions. If he tries at all to cope with the situation, he must adapt or modify his known responses or he must invent new ones.

The connection with creative thinking is obvious, but the same holds true for "divergent thinking" or "divergent production", which (according to Guilford's "structure of intellect model") reads formally as "generation of information from given information, where the emphasis is upon variety and quantity of output from the same source; likely to involve transfer" (Guilford, 1967, p. 213).

In order to be "productive", however, we need productive skills that allow us to formulate a problem and to solve it. In order to do so we rely on *divergent production* – abilities that embrace fluency of thinking (word fluency, ideational fluency, and associational fluency), flexibility of thinking

(readiness to change direction or to modify information), originality, and elaboration (elaborating on ideas and adding details to fill them out).

This topic has received considerable attention in music theory. Music theory, in fact, has historically received considerable input from models of the creative process (see also Chapter 1 in this volume): a great deal of post-war musicology has been concerned with issues of compositional creation, whether in the form of the genesis of individual works or a composer's creative process as a whole. Traditional research, however, has focused mainly on the compositional process (Bennett, 1976; Sundin, McPherson, & Folkestad, 1998; Van Ernst, 1993) or on methods for analysing the genesis of particular compositions of individual composers (Beethoven, Strauss, Hindemith, Sessions, and Stravinsky; see Cook, 1990; Cooper, 1990; Sloboda, 1985) rather than on the processes at work in musical creativity. This means that music theorists writing on compositional creativity have suffered somewhat from ignorance of psychological and related work on creativity so that their work has consequently lacked any kind of adequate theoretical grounding. What is needed, therefore, is a working definition of creativity that has descriptive and explanatory power as well. Johnson-Laird (1988) provides an interesting starting point in his description of the basic characteristics of the creative process: (1) it mostly starts from some given building blocks; (2) it has no precise goal, only pre-existing constraints or criteria that must be met; (3) it yields an outcome that is novel for the individual.

Following these lines of thought, Johnson-Laird distinguishes between three *computational architectures* for creation. The first is a *neo-Darwinian* architecture, which arbitrarily combines elements in order to generate putative products, and which uses constraints to filter out the products that are not viable; this is a highly inefficient procedure, because most of the products will not be viable. The second is a *neo-Lamarckian* architecture in which the organism adapts to the environment and can convey these adaptive constraints to its progeny: here a set of constraints is used to generate viable possibilities with an arbitrary choice being made from among them. Since only a relatively small number of products meet the needed criteria, this architecture is highly efficient. The third architecture, is a *multi-stage* design, which uses constraints both to generate ideas and to select the viable ones (Johnson-Laird, 1988, p. 258).

The translation of these ideas to the realm of music is challenging, as creative achievements involve both generation and selection. As such we can argue for a multi-stage approach to musical creativity. The whole construction, however, is computational in the sense that it relies on existing elements that are available for judgement and for assembling into novel arrangements, and as such it fits in with existing theories of creativity that take as their starting point a set of discrete elements on which to do the computations: conceiving of music in terms of pitches, chords, scales, arithmetically related durations, and other recognised groupings calls forth a formal-symbolic approach to music cognition, allowing the music user to process the music in

an autonomous way without perceptual bonding. It is also possible, however, to conceive of music in terms of a continuous renewal of the elements that are part of the music user's knowledge base. This position is related to the constructivist approach to music cognition, and stresses epistemic transactions with the sonic world.

Two questions are important here: what are the elements, and what are the computations we can carry out on them? In order to solve this problem we can rely on the control system and conceive of music users as learning devices building up semantic linkages with the sonic world. They behave as adaptive systems interacting with their surroundings through perception and action, and determining the categories of perception and action that are available to the system: unlike animals, which are constrained in their perceptual distinctions and actions on the world, a human organism can change its "semantic linkages" with the world (Cariani, 2001a). There is, of course, a lot of freedom here, but it is possible to reduce the virtual infinity of elements by perceptual and cognitive constraints. There is, in fact, a tension between things that can be denoted in an act of mental pointing and the mental operations that can be performed on them, and it is the latter (rather than the former) that are decisive in the delimitation of the elements (Reybrouck, 1999, 2003). Through the processes of selecting and delimiting, it is possible to improve our grip on the observables through the related processes of discrimination and generalisation. And the same holds true for such basic operations as assembling, ordering, and bringing into relation, which are closely related to the mental operations of classifying, seriation, bringing into correspondence, and combining (Piaget, 1967; Reybrouck, 2004). As such we measure and control the environment rather than merely representing it.

As to the elements, we might draw a distinction between *combinatorial* and *creative emergence*, with the former referring to the novelty that results from fresh combinations of pre-existing elements (Sagi & Vitanyi, 1988; Merker, 2002), and the latter refering to the *de novo* creation of new kinds of elements (Cariani, 1997). But I consider this distinction to be gradual rather than qualitative. Creativity in music is combinatorial in a radical sense, but it is creative only to the extent that the elements and their combinations yield a product that can be perceived as something new. As such there is always the possibility of making new distinctions and this is perhaps the hallmark of the creative musician, be it at the level of listening, performing or composing. Listening again and again to the same music, for example, can exhaust the possibilities of knowledge acquisition: in such cases, the music user no longer behaves as an adaptive and informationally open system, but as a closed system that has cut off its interactions with the sonic world. Rather than looking for new distinctions and observables, the system relies on recognition – in cognitive terms a highly economical strategy, since it is much easier to deal with symbolic representations that are already installed in the music user's mind than to build new representations in the act of dealing with the music.

This marks the basic distinction between *assimilation* and *accommodation*: the former allows the music user to perform mental operations in the absence of sensory input, while the latter involves a continuous interaction with the sensory material, relying on the rate-dependent processes involved in perceiving and acting. Once the music user has accommodated, however, it is possible to deal with the music at an internalised level as well, and this is basically the advantage of symbolic modelling and computation: it allows the music user to process music out-of-time, with the possibility of rate-independent storage and retrieval operations.

3.6 Conclusions and perspectives

In this chapter I have argued for a definition of musical creativity as adaptive behaviour at the three distinctive levels of the epistemic control system (input, output, and central processing). This means that we must consider the process of coping with the sonic world as one of measuring and controlling the sounding environment rather than merely representing it; in addition, it means that we can modify the cognitive and computational parts as well. This approach emphasises the flexibility of our cognitive apparatus and allows us to deal with music in terms of knowledge acquisition, thinking, and problem solving in general.

The three levels of the control system are moreover complementary components of creativity: they allow us to think of creative music users in terms of *adaptive semantics* and *syntactics* operating at the level of the epistemic control system. On the input side, we can conceive of musical creativity in cognitive terms, stressing the role of knowledge acquisition and the selection of new observables. This locates creativity at the input as well as the output side, a claim whose significance cannot be overstated: creativity in music is always related to exploratory listening, be it at a manifest (presentational immediacy) or virtual level (ideational mediation). The computational part, in turn, allows the music user to perform internal computations and symbolic modelling. The output side, finally, is more problematic, as many of the actions on the sonic world must be considered as internalised actions (mental operations), which belong to the computational part rather than to the output side. It is legitimate therefore to conceive of musical creativity as in part a bypassing of the effector part of the epistemic control system.

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Part II

Creativity in musical listening

4 Analogy

Creative support to elaborate a model of music listening

Irène Deliège

4.1 Introduction

As we know full well today, creativity in general can be approached in different ways (for a more thorough study of these topics and questions, see Sternberg, 1999). In this book we intend to show that this is also true of creativity in music and, more precisely in this chapter, of "creative cognition" in listening to music.

It is not only true to say that creativity needs to be studied in a specific way, depending on the field concerned. The concept itself and all that the word "creativity" covers – personal talent, specific aptitudes, divine intervention, inspiration, originality, etc. – have changed a great deal throughout history. Authors such as Albert and Runco (1999) even believe that "the concept of creativity has its own history" (p. 17) that runs from Ancient Greece to our times, and that it has always been of interest to philosophers and psychologists, indeed even biologists, mathematicians, and other specialists of pure sciences. The terminology has changed. Almost ten years ago, a new word appeared in the French language (Robert, 1996) – *créatique* – meaning all the stimulation techniques used in brainstorming sessions to encourage and develop individual creativity within groups or firms (Nickerson, 1999). It is therefore not surprising that new paths and models in research have developed, adjusting little by little to the different meanings of the concept of creativity itself (Rouquette, 1997, pp. 7–11).

Among the many views being explored today, a relatively recent one, the creative cognitive view, attempts to assess creativity in terms of innovative processes used by human minds on the basis of a heritage of knowledge stored in long-term memory (Smith, Ward, & Finke, 1995; Ward, Smith, & Finke, 1999). According to this outlook, the concept of creativity is considered to be a kind of continuum of emerging innovations that appear in the midst of the daily activities of an average individual. In extreme cases, they can give rise to distinctive and remarkable results in persons who are exceptionally gifted or who work within environments or circumstances that are conducive to the emergence of creativity. In these cases, research focuses on cognitive strategies that start out from a store of familiar and thoroughly

assimilated concepts to generate proposals, approaches or ideas that are new, yet deeply rooted in well-known ground, and that will later be circulated and accepted among the society. Four main possibilities are studied in this context. The first is conceptual combination: for instance, the fact of combining two or more concepts that are clearly defined but that, taken together, give birth to something new (Wisniewski, 1997). The second, conceptual expansion, suggests that methods well seasoned in a given field may be used for objects, facts, or circumstances for which they had not been conceived. Finally, we have metaphor and analogy, which are, in a way, relatively close and whose great importance for creativity is generally accepted. A century ago, Ribot (1905, pp. 22–23) wrote:

> The basic, essential element of creative imagination on the intellectual level is the ability to think in terms of *analogy*, in other words on the basis of partial and often accidental resemblance. By analogy, we mean an inexact form of resemblance: likeness is a genus of which analogous is a species . . . Analogy, an unstable, changing, polymorphous procedure leads to completely unexpected and novel combinations. Its quasi-boundless flexibility can yield absurd connections as well as highly novel inventions. (original emphasis)

4.2 How creation operates by analogy

Basically, analogy operates by initiating a process that compares items of knowledge belonging to fields that are not, at first sight, related. The first, which is very familiar and has been known for a long time, is considered to be the source, or reference, field. The other, more recent, which is still a subject of study, is the target field (Mathieu, 1991). The aim is to assess their level of correspondence so as to try to reduce the possible differences (Richard, 1990, pp. 137–157). Furthermore, as Margaret Boden (1988) points out, even though there is some disagreement as to the "precise" definition of the concept of analogy, "common to all uses . . . is some (not necessarily well-defined) notion of *similarity* . . . That is, the similarity must somehow be specifically exploited . . . [and therefore] may be regarded as the basic, minimalist, definition of the term" (p. 29). Such a definition, couched in these terms, goes back to Aristotle (trans. 1980, 21, 57b 6, 16, 25, 30).

The present contribution lies within the frame of reference of the "creative cognition" school. Or to be more precise, I wish to stress the creative contribution of analogy for the development of the different aspects of my *cue abstraction model* in the perception of a musical work (Deliège, 1987a for a first brief sketch, 1991, 1995). On a general level, analogy is at the very basis of many human cognitive activities, from the more automatic, (those that operate implicitly without the person even being aware of it), all the way to very elaborate and explicit forms that are active in scientific research, logical thinking, etc. By its very essence, it leads to a broadening of knowledge

through *connection* (Benmakhlouf, 1999, p. 35) that is by *fastening onto what is already known* and can thus develop further. This does not concern items of knowledge that are unrelated. This is the way analogy plays an important role in education and schooling. Jean-François Le Ny (1997) quite rightly emphasized that "no knowledge that *seems* to be new can become rooted in a mind unless it is *incompletely* new; in other words unless it finds a *welcome niche* in the learner's mind where it can be embedded" (emphasis added). However, it is only recently that interest has been shown in the experimental study of analogy's role in the field of psychology. Three main paths have been explored in the past 40 years. Setting aside their specific aspects, they are all rooted in the way the concept is understood in Aristotle's philosophy. Together they show how a known structure can help one to deal with a less familiar, indeed entirely new, situation. Relative instabilities and differences crop up in the way of using the concept itself to direct research models and to assess the impact of the similarity/resemblance, which underlies the comparisons generated by analogy transfer. It is expedient now to focus on this briefly before showing how analogy's contribution can be broadened to cover the study of musical perception.

4.3 The main psychological theories of cognitive processes using analogy

Aristotle (trans. 1967, I, 17, discussed in Gineste & Indurkhya, 1993, p. 144) draws a distinction between "similarities of properties", as for instance the analogy between the spine of mammals and the monkfish's backbone, and "similarities in relations" where, in the case of two different elements, there is similarity in their function or role within different organisms, as in the analogy between a bird's wings and a fish's fins. In the first case, we have a so-called analogy of *substance*; in the second, an analogy of *form*. But in both cases, the resemblance is objective and predates analogical transfer.

A more recent view, that of Black (1962), attributes to analogy the power of *creating resemblance* between fields that are different (Gineste, 1997, Chapter VI). Thus one can no longer speak of "importing" similarities from one field to another, but rather of deliberately "constructing" a relationship that, as it emerges, broadens the semantic domain of the target field. Thus, if you say "the men of this tribe are string beans", this suggests a picture of long, thin men. You have thus created an "opening", a novel way of expressing the attribute of "thinness"; but the two poles of the analogy remain unchanged. As soon as an analogy of this kind is posited, it requires that you fully grasp the two semantic fields that you are relating to each other. It also means that despite the fundamental differences between their own attributes – a man will never be like a vegetable, nor will a bean resemble a human being – you can extract properties that can throw new light on the two poles that you are connecting. This is the view of analogy suggested by the theory of *interaction*, studied during the 1990s by Marie-Dominique Gineste, Véronique Scart and

Bipin Indurkhya (see e.g., Gineste, Indurkhya, & Scart, 2000; Gineste & Scart, 1999; Indurkhya, 1998).

The model called *structure projection* developed by Dedre Gentner and colleagues has led to a number of empirical lines of approach and model construction in the past 20 years (Gentner, 1989; Gentner & Clement, 1988). It is based on a theory according to which former knowledge is used by analogy to construct a cognitive strategy for processing new information. Depending on the greater or lesser degree of similarity between the initiating structure (the source) and the end structure (the target), the projection of familiar structures onto the target field will be more or less effective. Gentner draws a distinction between *real* and *apparent* analogy, depending on the greater or lesser resemblance between the two terms of the analogy (Gentner & Clement, 1988, in Gineste, 1997, pp. 39–41). She considers that though the evidence acquired through analogy of appearance is superficial, it yields a surface similarity that is more direct and relevant for perception, thus more effective for cognitive processing. Similar aspects have been observed in the field of musical perception (see below).

On the other hand, Holyoak's school uses analogy for *problem solving*, and offers an alternative theory called *schema theory*. The point is to apply the rules that were successfully used in well-tested procedures to reach a different aim (Holyoak & Thagard, 1989). So one proceeds from an initial state to a target state, i.e., the solution sought, and thus a new pattern of rules is generated at the same time.

However, as Gineste (1997) points out, despite apparent diversity, analogue transfer actually covers a set of similar cognitive strategies: "in all cases, the aim is to import characteristics or properties from a familiar field, the source, to another, less well known, the target" (p. 83). But we must remember that there is never total correspondence between departure and arrival. At the end of the journey, less relevant traits remain. In other words one is left with a sort of *residue* whose importance must be assessed so as to exclude it if necessary, and avoid adulterating the possible creative result of the comparison.

4.4 Analogy in the cue abstraction model

The use of analogy in musical composition was frequent at certain times in history, mainly during the baroque, classical, and romantic periods. There were even tacit conventions that connected some timbres or registers to ideas outside the musical sphere. Think of the analogy between the sound of the flute and a bird, the horn and hunting, the oboe and rural settings, timpani and thunder, etc. Some musical structures, as for instance the location of sound in space, opposite registers, ascending or descending, discontinuous or continuous melodic curves, have even suggested analogy with spatial organization. Imberty (1979) recalls an example mentioned by Jacques Chailley (1963) from Bach's *Saint John's Passion*: "a melodic movement that descends

at the beginning of the first recitative . . . accompanies the descent of Jesus and his apostles towards the river, while an ascending movement goes with their ascent to the Garden of Gethsemane. The hierarchy governing Jesus' relation as the master with the apostles is often expressed by the difference in register in the Evangelist's narrative" (p. 8). There are many other examples one could mention: Michael Spitzer, in his recently-published book, *Metaphor and musical thought* (2004, p. 1), has in a way generalized the idea by starting his statement as follows:

> To think, talk, or write about music is to engage with it *in terms of something else* . . . Music "moves", "speaks", paints an "image", or fights a "battle". It may have a beginning, middle and end, like a story, or have line and color, like a picture. Music can even be a "language" with a lexicon and syntax. (emphasis added)

It is thus understandable that the idea of operating through analogy can readily occur to a musician who is trying to delimit the cognitive processes operating in music listening.

However, when analogy is used to define a model, it is no longer the type that I have just described. The point, then, is rather to emphasize certain *psychological constants* that contribute to the listening of music.[1] It would be wrong to think that the listener uses different psychological tools according to the type of music concerned. Furthermore, the use of analogical transfer in defining a model brings out one essential factor regarding the perceptual strategies involved, i.e., the fact that identical means can be used to process stimuli from different origins.

The following points will be discussed from this point of view: the formation of surface rhythmic groups that was the starting point of the idea to develop the use of analogy; the role of analogy in the hypothesis of cue abstraction, leading to the perception of segmentations and to the idea of a schematization or simplification of the musical information; the formation of categories, and that of *imprints* born of the process of category formation itself. The following discussion will show that in each of these phases, the comparison of processes used in listening to music and those described in other fields of psychological research has led to an extrapolation of former knowledge. The aim is to broaden the methods for clarifying the cognitive strategies used in music perception. Therefore, such extrapolation is based on *explicit* analogy as described by Benmakhlouf (1999) (see above).

4.4.1 In the perception of rhythm

Empirical work on the perception of rhythmic groupings (Deliège, 1987b) was the starting point for the study of the perception of a piece of music as a whole. This first step would be obvious for a music psychologist. But a second path was then suggested and became essential for this project. It was

suggested by the way of approaching rhythmic groups (Deliège, 1987b). At the start, it was used to assess the validity of Lerdahl and Jackendoff's (1983) preferential rules in this field. This approach had helped to show that the perception of music obviously has its specific aspects, but that it also largely shares important psychological constants that occur in other perceptual processes. It therefore seemed to suggest that there are types of psychological organization that are shared by a number of perceptual strategies, thus leading, given this particular observation, to the use of analogy in elaborating the organization of the different parts of the model, as will be progressively described hereafter.

At the basis of Lerdahl and Jackendoff's rules concerning the formation of rhythmic groups, there are certain principles that stem from the use of the Gestalt theory in the field of visual perception, source domain of the analogy. These are the well-known principles of proximity and similarity. It was immediately obvious that they could be used in the target domain: the organization of rhythmic perception. Similarity of form in the visual field could translate into the similarity of sounds with their different musical parameters: register, timbre, articulation, intensity. The concept of proximity in the field of vision was then transposed into time-space, thus defining groups of sounds (see Figure 4.1).

It was then obvious that one should go further and explore the possible relationships with other fields of psychological investigation, and so use contributions gained from fields other than musical perception.

4.4.2 *In the concept of cue*

It was mainly the results of psycholinguistic research that suggested the central assumption of the model: the idea of cue abstraction as the basic

Figure 4.1 (Left) Groupings in vision – the source domain – generated by the principles of similarity and proximity. (Right) The transposition in music perception – the target domain. "V" shows examples of segmentation points: 1st staff, principle of similarity (of register, 1st bar; of dynamics, 2nd bar; of articulation, 3rd bar); 2nd staff, principle of proximity (interval of time given by slurs, 1st bar; by a rest, 2nd bar; by distance between attack points, 3rd bar).

element used to control a stimulus that covers large time spans. Indeed, if you want to grasp the substance of a speech, you do not focus on the literal aspect of the text, but rather on certain essential points. You then try to reduce the information and you *simplify* so as to avoid burdening memory with useless details. Wilson and Sperber (1992, p. 227) stated that "the representation and the object represented are two different objects. They cannot . . . share all their properties. It suffices to share some of the most prominent ones . . . If I sum up an article that I have just read . . . you will never confuse my summary with the article itself." Thus, from the very start, you select so as to make reductions, to strip down to the main constituents. This idea is already present in the work of Frederic Bartlett (1977, originally published 1932) on the memory of narrative. It later became one of the main axes of research into the psychological organization of speech perception.

It seemed obvious, then, that listening carefully to a piece of music should, as in the case of speech, lead to the construction of a schema. And here the two poles of analogy came to the fore. It remained for us to see which tools could be used to construct such a pattern, considering that, contrary to a text, music does not refer to a directly tangible semantic content. It is here that the assumption of the existence of cues appeared. Abstracted during the process of listening, they are identifiable patterns – one could say salient peaks – that stand out and become firmly memorized as one listens, because they are relevant and repeated, either literally or with variations.

A cue always contains *rare* but striking features that tie it to the signal it refers to, thus making it recognizable. Charles Pierce (1978, p. 140) says in this connection: "A cue is a sign which refers to the object it denotes by virtue of being really affected by that object." It thus mainly acts as a *signpost*, a simple and effective way, as Ribot said (in Guyau, 1890, p. 66), of dealing with large amounts of data. The role of a *cue* is to generate abbreviations of units set up, actually reducing the amount of information that needs to be stored in memory. Consequently, by very definition, cues are labels, present at the start, but that are generally transient and fleeting. Memory does not store them all: a kind of "natural selection" takes place and only the strongest cues survive (Deliège, 1989, p. 214). They therefore are the prime elements of a gradual *reduction* of the piece, which is necessary for the organization of a mental representation.

The problem of coding this cue information then arises. How is the labelling for memory storage going to be carried out? Is musical information memorized in the form of an image or in verbal form? Do words come to mind while listening to music? Both types of coding are certainly present, but if you refer to Emile Leipp (1976, 1977), a great French master of musical acoustics, you find that a pattern is formed in the mind, an *acoustical image* of the cue, which stands out and becomes dominant in relation to the background of the music. Analogy is thus established at the very heart of Gestalt concepts, well known in the psychology of vision, the figure-ground concept, but applied to musical listening. Below, we will see how this *acoustical image*,

as Leipp calls it, can generate the perception of the major divisions of a work of music while it is being heard.

4.4.3.1 In the perception of segmentation

To fully understand the role of cue abstraction in the way in which the organization of a work is perceived, it was essential to look concretely at the assumptions suggested by the empirical approach. Was this really a process similar to the perception of speech, where different parts are separate, divided into sentences, paragraphs, etc.?

Some investigations were carried out with musical works of the contemporary repertoire, such as Luciano Berio's *Sequenza VI* (Deliège, 1989; Deliège & El Ahmadi, 1990) and Pierre Boulez's *Éclat* (Deliège, 1993), or earlier works such as the English horn solo from Wagner's *Tristan und Isolde* (Deliège, 1998). On that basis, I defined a procedure explicitly based on analogy. The results obtained with two types of participants, professional musicians familiar with this repertoire and non-musicians, were then compared. It was essential for the experimental procedure to give all the participants instructions that they could understand. If you ask a musician to signal the segmentations of a musical discourse by pushing a button, he will readily understand. For a non-musician, however, an instruction of this kind is meaningless. So it was necessary to resort to familiar concepts that could also be understood in this context. The analogy with the perception of speech afforded us the necessary basis. All the participants were asked to listen to the piece of music as if they were being told a story, and to signal the segmentations perceived by pushing a button on the computer keyboard.

As had been expected, the cues selected were obvious because they were repeated, literally or in variation. This means that they contained the *invariant* elements of the discourse (Hjelmslev, 1968), which are the starting points for categorizing new elements. Two principles are at work while listening: the principle of SAMENESS, whereby a group is considered to continue as long as the same invariant is recognized, and the principle of DIFFERENCE, which identifies boundaries and segments on the basis of a contrasting element that signals a break in the chain of structures defined by the principle of sameness.

4.4.3.2 In simplifying or reducing musical information

The next phase in the project dealt with musical memory and the role of the cues that led to the segmentation of the discourse. Have they, perhaps, defined a "plan" of the work?

Here, an analogy with Edward Tolman's cognitive maps (1948) suggested a well-founded relationship. In his work on rats, the author had observed, as early as 1945, that after a learning process, the animals were able to reach their food by modifying, when necessary, their path through the maze. Therefore

the rats were not limited to a sequence of repetitive movements. Tolman concluded that this meant that the rat was able to build a mental representation of the maze, thanks to its memory of mainly visual landmarks, rather than on the basis of solely proprioceptive, kinesthetic cues, as had been thought in the past.

For some time now, locomotion and the different aspects of the movement of an individual in his environment, along with the concept of *cognitive map* as mental representation of a site, have been a part of psychological research. Jacques Pailhous' book *La représentation de l'espace urbain* (1970) was really a starting point in the renewed interest in this problem. The author mainly deals with the mental map of Paris in the mind of taxi drivers, which they learned progressively in their daily job. He showed that there was a highly significant positive correlation between the maps as described by these subjects and the way in which they actually travel. Ulric Neisser, in his book *Cognitive Psychology* (1967), also emphasized the choice of visual landmarks in forming an image of a city. He also points out that these landmarks are a part of a quasi-hierarchical representation of the city and are included as local elements within a larger *cognitive map* (1976, pp. 123–124).

The same should be true of the mental representation of a musical work. The kind of organization generated by cue abstraction leads necessarily to the creation of a schema that reduces the total amount of information. Musicians, particularly analysts, are used to the concept of reduction. However, one thing must be made clear. A process of perceptual reduction that makes a mental representation of a work possible does not reproduce precisely the results of musical analysis. The analyst's tools are not necessarily aimed at perception. By definition, the type of reduction generated by cues remains focused on surface elements. This is not the case for models that stem from analysis techniques based on Schenkerian theories. In simplifying information through cue selection, the most readily grasped landmarks are the surface elements. This is why the idea of reduction based on cues can be used for any musical system, *since the model is based on general cognitive mechanisms*.

4.4.4 In categorization processes

We must now consider the way in which cues define categories when one is listening to music. The concept of category is understood here as meaning a *class of objects* that are linked by similarity.

Considering the importance of analogy, one could suggest that, on the basis of cue abstraction, the principles proposed by Eleanor Rosch (1975, 1978) in the field of semantic and conceptual representation could be used for music listening.

Rosch and her team, in what is considered today a classic work, have defined the dimensions of horizontality and verticality regarding categorization. Horizontality means that different elements are organized within a single set. For instance, imagine all the possible variations on a basic object.

Take a chair. There can be a number of models, where shape, material, colour, cover, etc. differ but they still belong to the same category. Obviously, musical perception can benefit from this principle of horizontality since the very first level of listening relates to the variations generated by a basic cell.

In contrast, verticality concerns relationships between categories and defines a hierarchy in their different levels. Rosch mentions three of these: the superordinate level, the basic level and the subordinate level.

At the top, on the superordinate level, a category is defined by its function. For example, clothing is a category of things that clothe a person. The intermediate category, or basic level, is the one that includes the largest number of objects that have common attributes and can be a part of the functional category "clothing" while remaining independent. In other words, they are not variations of each other. For instance, within the superordinate level of clothing, you have skirts, blouses, coats, trousers, etc. that are part of the basic level. But on the subordinate level, we have different variations of these: all the different styles of trousers, of coats, etc.

We have seen that the concept of *horizontality* could apply immediately to music listening. But for *verticality*, some adjustment is required. You cannot simply transfer to music the hierarchical principles that come from language and refer to precise concepts and semantic contents. But by analogy, one could say the following:

(1) The reference to a *basic level* could cover the abstraction of the different cues within a single piece. Each cue generates its own *horizontal* relations. It has its own specific function and creates its own auditory image, independently from all the others while sharing with them a common reference: the style of the piece.

(2) The *superordinate level* can then be assigned to the reference of each cue to a group or section, within the overall mental representation of the work.

(3) The *subordinate level* refers to relations between the patterns that share analogies within the auditory image, and this leads back to the concept of *horizontality*.

This leads to the concepts of *typicality* and *prototype*, to which I will add the notion of *imprint*, the second part of my hypothesis. Clearly, in any category, you find objects that are more or less marginal and that have imprecise cues. Furthermore, there always is, in a given category, an object that tends to be "central", the best representative of the series. This object, called *prototype*, is the one that contains the strongest and most valid cues.

Can we, on that basis, define a link between *imprint* and *prototype*? We know that the selection of *cues* has a corollary: they recur periodically, in one shape or another, but they are always recognizable. Does this mean that cognitive mechanisms will be able to follow them and memorize them extensively? Probably not, particularly if the piece is relatively long. On the

contrary, the salient cues will gradually engrave an *imprint* in memory while one is listening to a piece, or after hearing it several times. In other words, the sedimentary traces due to the accumulation of more or less varied iterations of the cues will become a kind of summary that grasps the main features of a set of presentations within a single basic structure. However, the concept of *imprint* must not be understood to mean a set of static traces, just as this is not true of the iterations of the cues themselves. It is rather a central trend, variable and flexible, that settles and adjusts as varied versions of the cues are presented.

The idea of imprint as applied to music must also be seen from a twofold point of view. The imprint works not only as a prototypical "summary" that facilitates the recognition of musical patterns. It is also a tool for recognizing the *style* of a work. The arguments developed by Mario Baroni (Chapter 5, this volume) are therefore in agreement with the concept of imprint. Unless the work or the style is already known, the imprint does not antedate the listening process. Rather, as it develops, the imprint incorporates not just the features of the category to which it belongs, but also those of the composer's style, a school, a historical period. It can thus become a detector of stylistic errors or deviations by defining limits between what, in a piece, is *typical* and what is not. The concepts of cue and of imprint formation therefore suppose that the architecture of the piece belongs to a style and a system that can be identified by the listener. These concepts would not be valid for the perception of aleatoric music.

4.5 Conclusion

The observation that imprint does not function in aleatoric music, at the end of a discussion about the creative use of analogy in revealing the psychological constants that underlie all perceptual activities, adds a complementary point: it suggests a direct link with the concepts of "good form", of syntax and with the analysis of visual scenes developed by the schools that have studied problems of perception and understanding of configurational situations. Irving Biederman (1981), in this respect, shows that there has to be a consistent system of relations between entities. He posits the *syntactic* aspects of the scene on one hand, and its *semantic* aspects on the other: in other words, that a set of conditions and constraints are necessary for the scene to be said to be "well-formed". For the author, *syntax* refers to the main physical constraints of the entities present, i.e., the fact that (1) they generally have a *basis* rather than floating in air; (2) they are almost always opaque and thus produce a phenomenon called *interposition*, which means that some entities can partly mask others. Transposed in the frame of music, these constraints are expressed by the organization of the sound structures in a given grammar and syntax that correspond to a style of a historical period, a particular school, a composer. On the other hand, by *semantic*, Biederman means constraints linked to the plausibility of the contextual situation, the dimensional norms of the objects and the likelihood of their location. Applied to music,

this should correspond to the probability of meeting such a kind of structures, such a number of instruments, etc., in some given context rather than any other. For instance, it would be completely unlikely to hear a tuba in the frame of a chamber piece of the classical style.

The imprint, formed during the process of listening, incorporates precisely comparable traits: an imprint can be established only on the basis of the syntactic system of the piece and all the constraints imposed by that syntax if the musical structures are to be "well-formed". Therefore the imprint includes limits that show whether the structures can be perceived as acceptable and convincing, plausible or unusual. In fact, one might posit that the basic background of what constitutes the notion of "experienced listener", as put forth by Lerdahl and Jackendoff at the very beginning of their seminal book *A generative theory of tonal music* (1983), is the cognitive strength of the underlying imprints kept in memory by such a listener. As specified by the authors on this point (p. 3):

> an "experienced listener" need never have studied music. Rather we are referring to the largely unconscious knowledge (the "musical intuition") that the listener brings to his hearing – a knowledge that enables him to organize and make coherent the surface patterns of pitch, attack, duration, intensity, timbre, and so forth. Such a listener is able to identify a previously unknown piece as an example of the idiom, to recognize elements of a piece as typical or anomalous, to identify a performer's error as possibly producing an "ungrammatical" configuration, to recognize various kinds of structural repetitions and variations, and, generally, to comprehend a piece within the idiom.

Thus, in the frame of the psychological investigation of music listening, the creative support of analogies led, in addition, to an emphasis on the uniqueness of the processes whereby we grasp information, showing that the essential economy of our psychological means leads our perceptual mechanisms to react by analogous strategies should the stimulus to process be a visual scene or a musical piece to listen to.

Note

1 Some of the following points are borrowed from an invited address (Deliège, 1992, with permission) read at the Second European Congress of Music Analysis, University of Trento (Italy).

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5 Hearing musical style

Cognitive and creative problems

Mario Baroni

5.1 Introduction

This chapter has two distinct aims: one is to discuss the kind of behaviours possibly underlying the process of recognizing a musical style; the second is to discover whether specific aspects of creativity can be observed during this process and how they are manifested. The chapter is divided into three main parts: the first is devoted to defining what is meant by “style” and “recognizing a musical style”; the second tries to pinpoint which of the numerous concepts of creativity might be applicable to the situation outlined in this chapter; the third part describes and comments on an empirical study that involved 13 subjects in a task of recognizing a particular example of musical style. Some general remarks on music listening are given at the end.

5.2 Recognizing a musical style

The concept of musical style can be analysed from different, convergent perspectives. None of them can really exhaust the complexity of its aspects, but there is a sort of interactive convergence between them: in order to obtain a description that corresponds to the many different forms the concept can assume in musical thought and musicological contexts, all such perspectives need to be taken into account. For this reason, the present section is necessary to introduce the content of the chapter and to explain some aspects of the experiment. I have discussed this problem widely elsewhere (Baroni, 2004). Here I limit myself to a brief summary of the three main areas that, in my opinion, are necessary and indeed sufficient for a good comprehension of the concept.

Firstly, let us consider the idea of style conceived as a system of structural musical traits. According to a famous definition by Leonard B. Meyer (1989, p. 3), “Style is a replication of patterning . . . that results from a series of choices made within some set of constraints.” This very synthetic and rather problematic definition needs clarification. The terms to be discussed are “replication”, “patterning”, “choice”, and “constraint”. Assuming that Meyer’s definition is still valid, though wide enough to include not only the author’s

conceptions but also other ideas that emerged during the 1990s, my discussion will not proceed in philological terms (with the aim of reconstructing Meyer's specific ideas), but will attempt to describe the meanings his terms have assumed in the context of different theories.

"Replication" is a real keyword in the study of style. All the contributors to the special issue of *Analyse Musicale* devoted to the analysis of style (no. 32, 1993) converge in stressing that without the replication of some structural traits a style can be neither analysed nor perceived. The behaviours of the subjects described below in section 5.4 amply confirm this phenomenon. The problem, however, is to give a more precise content to the word. In other words: the replication of what? Meyer tries to solve the problem by using the term "patterning", but this term itself requires explanation, which is not a straightforward matter. Style does, of course, involve replication, but what is replicated cannot always be correctly defined as a "pattern". Two different conceptions emerge on this point. For the conception of David Cope (2001), the term "pattern" can be properly used, since in his algorithmic reconstruction of musical styles he uses real fragments taken from stylistically homogeneous samples (patterns effectively replicated in the sample or at least considered equivalent or similar, as variations of one another) and combines them in sophisticated ways in order to obtain a new artificial work in the style of the model. In other words, his program EMI (Experiments in Musical Intelligence) examines the sample, cuts it up into fragments, and then extracts, categorizes and modifies the fragments, recombining them according to some defined procedures. Thus, this conception of a musical style can be correctly defined as a mixture of repeated patterns that may be present both in composition (EMI is a compositional procedure inspired by human composition) and in listening (the readers of the book are invited to listen to the artificial products of EMI and to compare them with the samples).

Another artificial intelligence program able to produce compositions in the style of a given sample, that of Mario Baroni, Rossana Dalmonte, and Carlo Jacoboni (2003), follows a different procedure based on a different theoretical background: the fundamental idea is that the structural organization of music is always the fruit of underlying rules, even though they are not always conscious. Some of them (for example harmonic, contrapuntal or formal rules) are explicit in traditional theory and are used in sophisticated ways in music analysis. Others (such as rules of texture or melody, and so on) are less explicit, but do exist: regularities in musical structures are always present and characterize the different musical styles. All musicians, all musicologists, and even the listeners are intuitively aware of their presence. The book quoted above is an example of how these intuitive regularities can be transformed into explicit rules applied to a particular repertory of seventeenth-century music. The question is: can the regularities present in a given repertory be defined as the "replication of patterns"? For example, in the specific seventeenth-century repertory, we studied how the length of the arias and of the phrases follows particular interrelated rules; the same can be said

for the sequence of cadences, for the use of particular melodic leaps, for the harmonic hierarchies, for the relations between harmony and melody, and so on. All of these structural features are regularly present in the different arias and together create a sort of intuitive stylistic coherence. In this style something, without doubt, is repeated, but this is not a pattern, a real sequence of notes: what is repeated is the application of the same rules that produces, for the listeners, an intuitive sense of similarity between the compositions of the same repertory. The human ear is sensitive enough to notice if in some different examples other different rules are applied, even if it is not aware of what rules have been changed and in what form (Storino, 2003).

In the latter theoretical view, specific emphasis is placed on the concepts of choice and constraint. In a given epoch, inside a given culture and in a given musical genre, there is a common repertory of musical stylistic rules (and the relative structural results) shared by the composers, musicians and listeners. From the constraints (or rules) imposed by a musical culture (a common, socially accepted "grammar"), a composer must make choices, which will differentiate their compositions from those of others. In Cope's theory, the concepts of constraint and choice are less underlined, but one might imagine that his way of combining fragments or patterns taken from a sample must follow different strategies (or systems of choices) in different stylistical contexts.

Another idea of style, however, can be taken into consideration: the second of the three main areas "necessary for a good comprehension of the concept" mentioned above. A style is a structure produced by a system of rules, or other forms of mechanical procedures. A work of art, like all forms of language or communication, must, in fact, be perceivable: it must be an object, the fruit of a construction, and in music the construction corresponds to a logical apparatus that even a computer can be taught to manage. But a human being, when composing, performing or listening to a piece of music, is less interested in the structure of the music than in making sense of it. A computer can produce music without any knowledge of its function or sense. A human being cannot ignore this point. This means that the structures are not assembled in a purely mechanical way, but according to a musical sense. In fact the grammatical rules are not abstract artefacts: they are historically and culturally motivated procedures always incorporating forms of aesthetic experience.

Leonard B. Meyer (1973) proposes some interesting ideas in this respect when he develops the concept of musical parameter. His theory implies that each bar or each moment of a composition is always a mixture of parametric situations (rhythmic, harmonic, melodic, formal, textural, thematic . . .). Each parameter contributes to the whole, both with its structural characters and with the cultural meaning it possesses, by virtue of a general consensus of listeners, composers, and performers belonging to the culture. Meyer's attention is particularly devoted to what he calls "closure". In a moment of closure, all the parameters more or less contribute to the same goal, and a

closure can be considered more or less strong depending on the mutual relationships between the different parameters. But there is no reason to think that the phenomenon of parametrical organization must be reduced solely to closure. An immense critical literature has been devoted, for example, illustrating how particular relationships between parameters produce the emotional contrasts typical of Beethoven's music or the sublime elegance of the Viennese classical tradition (e.g., Rosen, 1971).

In this context a theory can easily emerge: grammatical rules or other mechanisms producing structures are motivated by the aim of organizing an efficient balance between parameters at any given moment of a composition. The rules of a style (even if mechanically governed) must produce expressive effects, that is, a well-crafted relationship between different parameters: only in this case can they be accepted by listeners. Thus, recognizing a musical style cannot be conceived as a mere verification of the presence of certain structures, but also as an assessment of their expressive effects. In the experience described in the third part of the chapter particular attention will be devoted to this topic.

The third "main area" necessary for completing the notion of style regards the question of listening. A listener can have different approaches to music: the simplest, and probably the most diffuse consists of a mere abandon to the flux of sounds, where music is lived as an emotional stimulus and a source of immediate pleasure. In a context like this, there is no place for stylistic analysis. Recognizing a style, in fact, also implies another attitude, an objective approach to music. If the listener is interested in style they already know or would like to know the name of the composer; the listener must have a fairly precise knowledge of the cultural conditions where the music was produced, and must have the competence to distinguish its style from other concurrent ones. In other words, they must have had previous listening experiences of the style in question, and normally expect them to be confirmed. This, of course, involves recognizing its structures and making sense of them. From what we have just observed, however, it is clear that in order to assign a precise stylistic identity to a piece of music, another cognitive operation is necessary: Jean Molino (1994) defines this as *categorization*.

To explain the term one could begin by assuming that a division into categories is fundamental: to speak of music some sort of order must be given to the immense variety of the different forms available. Countless criteria have been used to regulate the variety of musical domain: geographical areas have been traditionally taken into consideration, but also social stratifications, epochs, musical genres, and personal choices. All these criteria can help to categorize a particular style. For example, for the so-called "classical style", geographical (Vienna), social (the aristocracy) and temporal criteria (the decades spanning the eighteenth and nineteenth centuries) have been adopted, while personal criteria have been added to distinguish Beethoven's style from Haydn's, and genre criteria to make distinctions between the style of a quartet and that of a piece of sacred music. The nature of these forms of

categorization is substantially pragmatic: it does not imply a rigorously objective or scientific definition. In Molino's theory the categorization of styles (like that of all human concepts) depends on the needs of communication: to speak in traditional linguistic terms, it is not an example of what Ferdinand de Saussure called "langue" but of what he called "parole" and depended on daily use. In musical style, linguistic conventions have been created for such needs, and have been confirmed by a long musicological tradition. But a stylistic category does not depend only on historical or cultural knowledge. Within the category, the different examples pertaining to its domain are mentally organized according to prototypical models: some such examples are at the core of the style and represent its fundamental characters, while others are increasingly more marginal, or can be considered at the borders of other styles. These points can obviously give rise to very subtle musicological discussion, beyond the scope of the present chapter. However, problems of this type actually emerge in the experience described in section 5.4, and will be discussed later.

This introduction has attempted to arrive at a better definition of the concept of style, which is necessary in order to deal with the topics of the chapter correctly. Obviously it represents no more than a preamble to the knowledge of the psychological nature of style. A deeper analysis of the mechanisms present in listening to a piece of music, including aspects of memory, categorization, cue collection, or the elaboration of a synthetic "imprint" of the piece, has been proposed by Irène Deliège (2001a, 2001b). The concept of imprint has been presented by Deliège (1989, 1992) as a "prototypical summary leading to an easier organisation for identifying the style of the piece".

5.3 Creativity in musical listening

Studies of creativity have generally been conceived to explain the mysteries of exceptional persons, the brilliant discoveries that are commonly considered as milestones in the history of human civilization. In a famous book, Howard Gardner (1993) considered Einstein, Stravinsky, Picasso, Gandhi, and other such subjects. In this chapter, to study creativity, I will consider a modest group of subjects surely not chosen for their musical genius. Studies on creativity have, in fact, had the merit of demonstrating that this faculty, like intelligence or musicality, is a common possession of all human beings: "At an individual level, creativity is relevant, for example, when one is solving problems . . . in daily life. At a societal level, creativity can lead to new scientific findings, new movements in arts, new inventions, new social programs" (Sternberg & Lubart, 1999, p. 3). In this context, therefore, I am not interested in new social programmes or, rather, in the relationships between creativity and cultural life, nor in "person-based" studies about motivations, personality, and so on. I will limit myself to taking into account the studies of the cognitive aspects of creativity. For this purpose I will examine some of the

main contributions on the relationships between creativity, knowledge and problem solving.

Robert Weisberg (1993) asserts that there is a problematic relationship between knowledge and creativity. According to a traditional point of view, knowledge tends to induce stereotyped responses and to inhibit spontaneous creativity. The lack of creativity does not, however, depend on previous knowledge, but on the attitude of the subject towards it. A creative attitude is present in subjects able to freely use their knowledge, without repeating what they have learned in excessively automatic ways. On the other hand, without some form of knowledge, no creativity can be developed. This issue frequently arises in our research, where it is sometimes difficult to decide whether a trite answer results from a lack of creativity or a lack of information. On the relationships between creativity and intelligence, the best known model, not recent but still appreciated and useful, is that of Guilford (1967): it is a psychometric model based on a great number of tests devised to measure mental abilities; but it also presents cognitive hypotheses on the processes that are at the basis of such abilities. The principal factors identified by Guilford are *fluency* (a large amount of mental productions), *originality* (a production of nonstereotyped, "divergent" answers), *flexibility* (the ability to adapt one's own knowledge to different situations), and *sensitivity to problems* (the ability to recognize – not only to solve – problems). These factors cannot always be used quantitatively as measures of creativity, but there is no doubt that they can be interpreted as cues to the presence of some creative aspects. In such a way I have used them to interpret the answers of the subjects in the research outlined below.

Another important source of ideas is the so-called "creative cognition approach", which places particular emphasis not only on the named features, perhaps following Guilford's tradition, but on the whole context: the "generative" context where creative thinking normally operates. This point of view suggests that a clear distinction should be made between this particular context and others: the specific situation of a creative context is characterized by the necessity to solve some problem and to find all possible resources for its solution, starting from the evocation of past experiences and of associated memories. According to Ward, Smith, and Finke (1999, p. 190):

> to construct a vast array of . . . concepts from an ongoing stream of . . . experiences implies a striking generative ability . . . We seem able to create goal-derived categories as we need them to satisfy the requirements of the immediate situation . . . these generative cognitive processes . . . are part of the normative operating characteristics of ordinary minds.

A more precise description of the "generative" situation is given by the so-called geneplore model proposed by Finke, Ward, and Smith (1992), based on two mental processes: that of the *gene*ration of structures ("generative phase") and that of their ex*plora*tion ("exploratory phase"). The two

processes are interrelated and are characterized by alternating repeated cycles. "The most basic types of generative processes consist of the retrieval of existing structures from memory and the formation of associations among these structures" (p. 20) or combinations of them, or transformation of existing structures into new forms, or analogical transfer of information from one domain to another (Ward *et al.*, 1999). A particularly important result of this process is what the authors call "conceptual expansion" (p. 195), whereby each subject:

> might begin with a familiar concept . . . and create something new from that base. In so doing, each would extend the boundaries of the existing concept, and each would craft a product bearing critical resemblances to prior instances of the concept.

In the particular situation of our research, as we already noticed following the suggestions of Jean Molino, we are dealing not only with concepts in the strict sense of the word, but also with more specific categories: with musical "prototypes", each corresponding to a style, each endowed with a given name. The result of this cognitive phase is the production of a number of "preinventive" mental structures. Exploratory processes imply an analysis and interpretation of the preinventive structures stemming from the first phase: for example, according to Finke *et al.* (1992, p. 25) they act by:

> exploring the potential uses or functions of a preinventive structure . . . or considering a preinventive structure in new or different contexts . . . Preinventive structures can also be explored in the spirit of hypothesis testing, where one seeks to interpret the structures as representing possible solutions to a problem.

This kind of mental work corresponds perfectly to some of the behaviours of the subjects of our research, when they recall various forms of listening experiences, find interrelations between them, compare them, and try to formulate hypotheses in order to find an efficient solution (exploratory process) to the problem of identifying the style of the excerpt listened to.

The quoted authors give many examples of visual imagery in their book, but no example pertaining to music. Although music is actually represented in a number of books and articles on creativity, authors tend to concentrate on the most famous musicians, from Mozart to the Beatles, and attention is never focused on the mental processes involved in making music, but on other problems: for example, measuring the relationships between the age of the composers and their presumed "melodic originality" (Simonton, 1990), or other such amusing phenomena. More specific attention to music can be found in the pedagogical tradition, where the presence of genius has a minor impact. Good examples of panoramic articles in this field are those of Webster (1992) and Hickey (2002). In this area, however, most attention

is devoted to the study of music production and more specifically to composition, which is often simply identified with musical creativity. Much less space is set aside for the study of listening. The only contributions this author could find in the literature are two doctoral dissertations quoted and discussed by Webster, by Saul Feinberg (Temple University, 1973) and Clifford Pfeil (Michigan State University, 1972), and an article by Robert E. Dunn (1997).

Feinberg studied problems of fluency and flexibility in the context of musical listening, by means of exercises proposed to the subjects. For example: "After listening . . . make up a series of questions that you think related to what you heard."; or "While listening . . . place a check after any of the music qualities listed." (changes in tempo, dissonant chords, etc.); or "After listening to two different recordings of the same composition . . . describe what you think the second conductor did that was different from what the first conductor did." (Webster, 1992, pp. 276–277). The work by Pfeil (Webster, 1992, p. 277) aimed to transform a traditional course in music appreciation by discouraging passivity and encouraging divergent thinking and openness to elaboration. The students were involved in a number of exercises and experiments. One consisted of a simple improvisation activity, which was taped and played back; then a question was asked: "How can this be made more interesting? . . . The students suggested many problems and solutions." Another exercise consisted of presenting a brief score with graphic signs on three staves. The students had to imagine a concrete piece for sax, trumpet and drums, based on their mental hearing, and then list as many things as they could that they did not like about it.

Dunn's (1997) article begins by quoting the opinions of many musicians and musicologists about the creative aspects always present in listening to music, and after listing some of these aspects – primarily affective and imaginative responses and extra-musical references – proposes an "exploratory study" aimed at concretely demonstrating their presence and their functioning. Twenty-nine subjects were asked "to visually represent ('map') what they heard in a musical excerpt . . . A figural map is an icon-like visual representation of a music piece which encodes certain melodic, rhythmic, and formal information" (p. 45). The term "figural" has been adopted from Bamberger's studies on children's representations of rhythm. In reality, imaginative or extra-musical responses do not seem to be present in these maps: all the subjects were simply asked to make a graphic figural map of the same piece, then to "perform" their map by tracing it with a finger as the music was played, and finally to "perform" the maps of some of their colleagues. Verbal comments were transcribed and examined (Dunn, 1997, p. 54):

> While there were some commonalities in the maps, differences were numerous . . . This variety indicated that music may indeed be co-created by the listeners . . . The fact that the students were encouraged to think "outside the box" allowed some of them to feel more open . . . Several

students remarked that this activity had changed the way they listened to music outside of class.

5.4 Interviews on the recognition of a musical style[1]

5.4.1 Subjects

An almost unknown fragment of a quartet by Gaetano Donizetti[2] was presented to a group of 13 subjects who were asked to guess the composer. The group consisted of five musicologists (subjects 1–5), four musicians (two performers, subjects 6 and 7; one composer, subject 8; one teacher, subject 9), and four non-professional subjects (two amateurs, subjects 10 and 11; two students not expert in the repertory, subjects 12 and 13). The goal of the research was not to see which subject would be able to recognize the composer (none of them actually guessed correctly), but to observe which procedures were adopted to solve the problem, and under what conditions. In order to increase the possibilities of comparison, several slightly different situations were created.

5.4.2 Method

Each subject was given a tape recorder (with earphones), containing the fragment by Donizetti, and another recorder to record their comments.

5.4.2.1 Condition 1

For subjects 6, 7, 9, 10, 11, 12, 13, the initial request of the "interviewer" was: "You will listen to a fragment of music. Please try to guess the composer. You must say, in the most simple and truthful way, what paths you follow in order to solve the problem. You can speak preferably during the listening itself, but you are free to continue afterwards and to listen to the piece more than once".

5.4.2.2 Condition 2

Since Donizetti wrote his quartet under the strong influence of the models of classical Viennese style (at the suggestion of his teacher Giovanni Simone Mayr), the composer–musicologists group was given an additional piece of information: "The composer of the quartet is not Haydn, Mozart or Beethoven".

5.4.2.3 Condition 3

After participants had suggested a possible composer, the true name was revealed, and they were then invited to comment on this new aspect. As already observed, the research had no psychometrical scope: there are still

too many gaps in our knowledge to permit a rigorous formalization of the data. A strong preference was given to a more informal approach to the reactions of the subjects and to a "qualitative" discussion of their answers.

5.4.3 Results 1: Recognizing Donizetti's style

The research was conceived as a pilot study whose goal was to make a preliminary exploration of the field. The "interview" form of the approach with the subjects obviously produced consequences for their relationships with the interviewer: some of them were more prudent, with frequent silences, others were more jaunty, some were a little embarrassed, and others simple and natural, with evident consequences for their responses. In all cases, however, the idea of playing a sort of intellectual game greatly prevailed over their fears and in the end the contents of the interviews always assumed an acceptable form.

The analysis of the answers aimed to accurately observe two different situations. On the one hand attention was given to the procedures followed by the subjects in recognizing the style of the musical excerpt; on the other hand the intention was to consider what aspects of creative thinking were manifested by the subjects, on what occasion and under what conditions. The results will thus be divided into two separate categories: Results 1 (this section) and Results 2 (Section 5.4.4).

The analysis of the answers will be divided into two fundamental phases corresponding to the predominant attitude assumed by the subjects: the first has been named "looking for orientation"; the second "looking for confirmation". In the latter case the subjects adopted three ways to find cues that could confirm (or refute) their initial orientation: "use of historical information", "use of analytical competence", and "looking for the musical sense". These various attitudes were not adopted according to any logical or chronological order, but were mixed and often depended on the interrelationship with the interviewer.

5.4.3.1 Looking for orientation

This point is dominated by the evocation of stored memories organized in prototypical forms, and by implicit or explicit mental comparisons. Finke *et al.* (1992) would speak of "preinventive structures". The definition they give to this phase, the "retrieval of existing structures from memory and formation of associations among these structures", corresponds to the words our subjects used during the exercise. In this orientation phase, three prototypical stylistic categories variously enter into the mental play of the subjects: epoch (1700–1800); genre (quartet); and place (Vienna). In order to obtain an initial orientation the subjects must have a prototypical image of how eighteenth-century music sounds, as opposed to nineteenth-century music. Subjects of different categories (3, 7, 9, 10, 11, 12) initially chose one of the two

centuries or passed from one to the other. One subject (13: not expert student) immediately declared his lack of competence in this kind of music (which can be interpreted as lack of stored memories). Other subjects avoided mentioning the centuries (evidently considered too obvious) and preferred to speak directly of classical style. The "quartet" category is not only linked to the timbre of the instruments: a person who possesses a prototypical image of a quartet must also know the emotional character of the category, linked to its historical and sociocultural traditions. The majority of the subjects knew well what a quartet is, although for one of them (again subject 13) the word explicitly meant nothing; two of them (11, amateur; 12, not expert student) did mention string instruments in their answers but did not mention the genre: we could deduce that in their minds there is not a clear prototypical image of the quartet category. The third prototype (Vienna and classical style) seems to be well assessed in the memories of most subjects (except subject 13), but in some cases of amateurs or students (subjects 10, 11, 12) the name of Mozart is used instead of that of Vienna. The famous composer has become a sort of symbol of the whole epoch. This could be interpreted simply as a lack of historical information about classical style; more probably, however, the name of Mozart does not strictly represent classical style, but the spirit of the epoch. This means that the exact prototypical musical image of Viennese style does not have a clear individual existence but is included and submerged within the wider image of eighteenth-century music. I conclude this point with two observations: firstly that I have used the term "prototypical musical image" in a merely intuitive way. I consider its existence as a plausible hypothesis, but I know very well that it is far from being confirmed by empirical, experimental demonstrations. Secondly I underline once again that the proposed interpretation of subjects' responses is to be intended simply as a probable or plausible one, always open to other possibilities, without any ambitions for it to be considered scientifically true.

5.4.3.2 Looking for confirmation

This phase corresponds well to what Finke *et al.* (1992) call exploration, defined by them as "analysis and interpretation of the preinventive structures". At first glance, one immediate observation is that in the answers of many of the subjects the "confirmation" phase (historical information, analysis of the structures, or looking for the sense of the piece) was reached directly without any previous general "orientation". This does not mean that the first phase was actually absent, but simply that it was not mentioned by those subjects, probably because they considered it unnecessary or too obvious.

The first phase of orientation always leaves doubts and is not enough to solve the problem posed by the interviewer, but a specific, more accurate analysis of the piece is particularly necessary for those who have had the negative additional information: not Haydn, not Mozart, not Beethoven (subjects 1, 2, 3, 4, 5, musicologists; and 8, composer). Recourse to historical

knowledge is reserved to those who obtained it by studying or reading: in fact subjects 10–13 (amateurs and not expert students) did not use it. Names of "minor" composers inevitably appear in the answers of subjects 1–5 and 8, whether of German-Austrian origin (Diabelli, Kalkbrenner, Czerny: subject 1) or of Italian provenance, either from the eighteenth (Cimarosa, Boccherini, Cherubini: 4, 5, 8) or the nineteenth century (Paganini, Carulli, subject 4).

A particular status can be attached to the analysis of structures, somewhere on the borderline between "historical information" and "looking for the sense of the piece". The difference between analysis and historical information is that the latter derives from reading and the former from listening. The difference between analysis and "looking for sense" is that the latter refers to an interpretation of the whole piece and the former to the analysis (and sometimes the interpretation) of a particular structural aspect of it.

More generally speaking, "analysis of the structure" always implies three specific properties: the first consists of the ability to perceive particular structural categories (harmony, phrasing, and so on); the second, the fact that these structural perceptions are always recognized as components of a specific prototypical dimension (the style of Beethoven, or of eighteenth-century Italian composers, and so on); thirdly, the fact that these "sub-prototypes" (the style of a single composer or of a specific stylistic area) are compared with one another in order to assign a stylistic interpretation to the structural perception under analysis. These properties are obviously reserved to subjects that possess a well-developed historical knowledge and a refined listening habit.

An adequate lexicon is also necessary to manifest mental procedures like these, even if in the answers of our subjects metaphoric language is absolutely dominant (which means that they do not limit themselves to analysing, but they also interpret what they perceived). For example: "lacking in harmonic *boldness*", "*well-balanced* phrasing", "rhythm-motor *activism*". As regards "looking for the sense of the piece", the answers may be of a different nature: for example, "the level of elaboration is simple but the piece has a pleasant freshness" (subject 2, musicologist) is an assertion that combines analysis, interpretation and aesthetic judgement, but has only vaguely to do with a stylistic assignment. Other answers (both from amateurs) seem to be more pertinent to style, even if they are expressed through images: "it sounds like a sort of accelerated Mozart" (subject 10) or "an Austrian-Hungarian author on a tourist trip to Venice" (subject 11).

Finally, some answers imply forms of prototypical experiences and memories, similar to those of the orientation procedures. In these cases, however, the need to provide a plausible answer tends to induce some subjects to propose imaginary solutions not always corresponding to a precise historical context: for example, when subject 8 (composer) speaks of "an Italian musician linked to opera" or subject 9 (teacher) speaks of the "early years of the twentieth century" they evidently have in their memory aspects of possible stylistic models extracted from a wider context, but since at that moment they cannot

have any precise control over the historical existence of such models, they are compelled to leave them as vague products of their imagination.

5.4.4 Results 2: Aspects of creative thinking

Before describing aspects of the answers containing possible forms of creativity, a few initial words are necessary. The literature previously quoted insists on a strict relationship between previous knowledge and creativity: for example, simply repeating what has been learned does not manifest creativity; but also, giving an original, unexpected answer to a problem cannot be considered a creative act if it does not correspond to an effective solution, because of the lack of necessary knowledge. In our research the two extreme positions could be exemplified with two hypothetical cases: if a subject had said that the piece belonged to Renaissance polyphony, the answer could be considered unexpected and divergent with respect to the others, but its evident absence of knowledge would have qualified it as useless for solving the problem. On the other hand, if a subject had already played the quartet in question as a violinist, and had said that the piece was by Donizetti, he would have solved the problem but without any creative effort.

So a creative act regarding the solution of a problem implies two conditions: that a solution exists and requires some knowledge, and that the subject possesses the necessary knowledge but does not know the solution. In this context the answer proposed by the amateur subject 11 ("the piece recalls an image of aristocracy associated with the town of Venice") seems original but not competent enough. A particularly ambiguous case is that of subject 5 (a musicologist): in his orientation phase he advanced the "divergent" hypothesis that the piece could manifest aspects of pre-classical, late baroque style. The answer is original, but it is very difficult to actually find a prototypical late baroque model that could include the piece. On the other hand the same subject in other answers demonstrated a good knowledge of different styles of the epoch. How, then, can this particularly "divergent" behaviour be classified? As too strong a tendency towards original solutions? An underestimation or a momentary forgetting of the limits imposed by musicological knowledge? The case is difficult to interpret.

5.4.4.1 Creative solutions

Various examples can be proposed: one is offered by the ability to find original categorical perceptions to be inserted in useful prototypical models (composer subject 8: "a brilliant Rossinian rhythm", and "opera-like phrasing"; musicologist subject 4: "an Italian composer from the nineteenth century who adopts an old style, while reducing tensions, and looking for more graceful results"). Another example consists of choosing historical memories that are not too obvious (performer subject 6: "It does not correspond to any of Beethoven's opus 18 or opus 59 quartets"). Forms of flexibility in varying

their attitude are also present (the same performer, subject 6: "the rhythmic rapidity made me think of Beethoven, but I changed my mind because of the too simple exchanges between the instruments"). Other forms of creativity are manifested by the presence of nonstereotyped images (amateur subject 10: "an accelerated Mozart") or of relatively nonsimplistic lexical choices (musicologist subject 1: "rhythm-motor activism").

5.4.4.2 After finding out the name of the composer

Two types of reaction were found. The first is a sort of defence or justification of the previous choice. In other cases, however, a particularly flexible behaviour becomes evident and produces a sort of re-equilibrium of the preceding hypotheses: different importance given to some perceived aspects can radically change the initial perspective and can produce a totally different hierarchy among the components of the whole image of the piece. For example, many subjects (musicologists 1, 4, 5 and composer 8) observed that the relationship between instruments is more a dialogue than a counterpoint and that this dialogue almost takes on the dimension of exchanges between masculine and feminine voices, as in opera. Subject 5 explicitly asserts that in the previous listening he was "too concentrated on other less relevant problems".

5.5 Conclusions

In section 5.4.3, devoted to style recognition, one of the most useful concepts to help explain the subjects' answers was prototype, conceived as a hierarchical organization of memorized listening experiences, oriented by historical knowledge. Historical knowledge offers categories such as the classical Viennese epoch, Italian eighteenth-century instrumental music, Beethoven's compositions, or opera composers, and each of these conceptual categories is accompanied by a synthetic musical image of its style, a musical "prototype" that can correspond, in the minds of the subjects, to a more or less precise and coherent complex of sound memories.

In section 5.4.4, devoted to creativity, the principal points of reference can be found in the discussion of the problematic relationships between competence and invention, and in the frankly rather surprising presence of old Guilfordian concepts (originality, flexibility, and so on) that still prove very useful to explain some aspects of the subjects' answers.

A final observation about creativity can also be drawn from the research: listening to music should not be considered a creative act if it is simply motivated by the pleasure of listening. Only when some form of problem arises can a creative attitude be adopted in order to solve it. For example, if a listener, when listening to a piece by a well-known composer, does not find confirmation of their expectations, their attention could increase and they could try to solve the problem of understanding why the piece did not

correspond to the initial previsions. If a listener, when listening to a new piece, happens to be surprised by new sounds and is obliged to find new ways of interpreting them, this could be considered another kind of problem. A suggestion by Wiggins (2002, pp. 79–80) might be added on this point: "Listening is a creative process in that individuals hearing and interpreting a piece of music recreate the music in their minds as they listen, bringing personal interpretation to the experience which makes it meaningful". What he defines as "personal interpretation" adds something to a mere passive listening: it implies the presence of a sort of problem requiring a solution. In the examples described by Feinberg (1973) and Pfeil (1972) (both cited in Webster, 1992) and Dunn (1997), the problem was very clear: listening was always accompanied by an exercise or an experiment. But it is not exclusively in conditions like these that creativity emerges and can be studied. What Finke *et al.* call "generative problems" and what they analyse by means of their "geneplore" model is presented by them as a general condition for the activation of creative thinking: only the occurrence of an external stimulation (identifiable as a problem to solve) can provoke its existence. The "problem-solving" hypothesis can be advanced here only in purely theoretical form. In order for it to be confirmed or demonstrated, an empirical research project would be necessary. My hope is that in the not too distant future such a project can be planned and realized.

Notes

1 The term "interview" has been used here instead of "test" or a similar expression, for two reasons: because the information retrieval was not strictly formalized, and because its form was similar to that of an interview (cassette recorder, microphone, etc.). Its contents, however, consisted simply of an initial request by the "interviewer" (the author of this article), a series of free answers given by the subject, and possibly a few other prompts from the interviewer when absolutely necessary.

2 Quartet n.8 in B flat major (1819). Last movement in sonata form: bars 1–172 (exposition). Taken from Donizetti, G., *Diciotto Quartetti* (Istituto Italiano per la Storia della Musica ed.), Francisco Prati, Rome and Buenos Aires, 1948. Performance of *The Revolutionary Drawing Room*, in the CD *Donizetti String Quartets 7–9* (cpo 999 170–2). Duration of the fragment 1 min 45 s.

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Part III

Creativity in educational settings

6 How different is good? How good is different? The assessment of children's creative musical thinking

Maud Hickey and Scott D. Lipscomb

6.1 Introduction

You've just collected your fifth-grade students' MIDI[1] compositions and, with a hot cup of coffee in hand, are settled down and ready to listen to them from your computer. The assignment for the children was to compose a song on the synthesizer using notation software. The song was to be eight measures long, in 3/4 time and in the key of B♭. You emphasized that students use B♭ as their "home tone"; that is, they were to use that pitch at least three times in the composition and also to end on the B♭. Your purpose, as a teacher, was to teach about and reinforce the concept of key centeredness (i.e., tonality), as well as to determine whether the students understood 3/4 time. A second – no less important – purpose for this assignment was to give children the chance to be creative in their approach to learning. You smile and nod as you listen to the first ten or so compositions, all just a little different, but mostly the same: clearly following the parameters that you set to create a simple, single line melody. But when you get to Nora's song you are startled. Though she *did* write in 3/4 time and used the B♭ as asked, she clearly experimented with several different timbres and composed a jagged atonal melody full of wide leaps, accompanied by alternating loud/soft tone clusters using an electronic-sounding timbre. It didn't sound very "good" to you, yet it was somehow interesting. Was it a random mess? Or did Nora compose this song deliberately? How should it be graded? How do you respond to Nora? It certainly was not nearly as "neat" and tonally "centered" as the other student compositions. In fact, it was downright strange. You're stuck with these questions, yet also intrigued by what Nora composed.

Every music teacher who has incorporated composition exercises in their music classroom has undoubtedly experienced something similar to the imaginary scenario described above. For those who typically give less structured, more "open" assignments (with virtually no parameters), the percentage of "peculiar" sounding compositions is even greater. Upon first hearing, the most unusual compositions may be dismissed as "wrong", or "not following the rules", or simply "bad". Our music teaching culture tends to favor the

"safe" side – that is, providing structure in composition tasks in order to assure that students create something that sounds "good". Teachers feel more confident assessing the more structured, neat, "tonal", approaches to music creation, especially if they have not been trained formally in music composition. Yet experimentation and novelty are the *sine qua non* of creativity. How can we facilitate student learning and creative use of both the worlds of rule-bound composing and free creativity? What means can we utilize to determine when a child has acquired the ability to combine these worlds?

What constitutes a *good* composition? What constitutes a *creative* composition? Where does "highly unusual" fit in? Can different be good? How can good be different? To answer these questions and address the issues posed above we will examine approaches to assessment in creativity and in ethnomusicology, and share a study in which the present authors have applied these approaches to the assessment of elementary children's musical compositions.

6.2 Approaches to the assessment of creativity

As the "grandfather" of creativity assessment, J. P. Guilford's long quest to measure creativity began with his 1950 address to the American Psychological Association (Guilford, 1950). Guilford's Structure of Intellect (SOI) model proposes 180 cells of thinking operations. Thirty of these cells fall under divergent production abilities that Guilford (1967, 1988) proposed as important to creativity. Tests that measure creativity based on the SOI model measure the variables of fluency, flexibility, originality, and elaboration. The *Torrance Tests of Creative Thinking* (Torrance, 1974) are the most widely used standardized tests of creative thinking that emerged from Guilford's SOI model.

In music, Webster (1994) adapted these four factors to create the *Measurement of Creative Thinking in Music* (MCTM). It is probably the most well known and thoroughly researched tool for assessing creative thinking in music. In the MCTM, the student is prompted to perform a series of improvisations based on imaginative scenes, such as a robot in a shower, a frog jumping on lily pads, or a rocket launching into space. The student responds to these prompts using a foam ball on a keyboard, their voice in a microphone, or temple blocks. The resulting musical improvisations are recorded and scored for extensiveness, flexibility, originality, and syntax, as well as overall musical creativity.

The foci in both the Torrance and Webster approaches are to rate the overall creativity, or creative thinking ability, of the test taker based on the premises that creativity can be measured through test exercises, and is based on the factors of fluency, flexibility, originality, and elaboration. For the purposes of this chapter, we are interested in observing the creativity of children's music compositions and examining the efficacy of social methods for measuring these.

6.2.1 Creative product

A widely used definition of a creative product is that it is both "novel" and "appropriate" (Amabile, 1983; Baer, 1997; Davis, 1992; Mayer, 1999). Of course, "novel" and "appropriate" can and do have a variety of meanings depending on the context. A main consequence of this definition is that a product that is *only* original without any sense of appropriateness or usefulness in the culture is not creative, and vice versa – a product that is appropriate or valuable without any degree of originality is not creative.

What we find to be a very useful definition for creative products when dealing with children is that offered by Baer (1997, p. 4): "Creativity refers to anything someone does in a way that is original to the creator and that is appropriate to the purpose or goal of the creator". This definition supports what some call "small c" creativity (Feldman, Csikszentmihalyi, & Gardner, 1994; Gardner, 1993), whereby every person is more or less "creative", and the "more" or "less" is in comparison to others in their cultural and social context. For children in a classroom, then, the most creative products are those that are the most unusual, yet appropriate, in the context of that classroom or age-group within that cultural milieu. "Appropriate", in this context, means aesthetically interesting (this might be pleasing or not pleasing: simply catchy or unique). A musical composition for a 10-year-old child that is considered "creative" will be interesting as well as novel or unusual in comparison to others in her age group. Nora's composition described in the opening scenario would fit into this category.

6.2.2 Consensual assessment

Amabile (1983) devised a "consensual assessment technique" (CAT) for rating the creative quality of art products, which aligns with the definition of creativity described previously. The technique is based on her consensual theory of creativity, suggesting that creative ability is best measured by assessing the creative quality of the products that are a result of creative endeavors. Furthermore, Amabile proposed that subjective assessment of such products by experts in the domain for which the product was created is the most valid way to measure creativity. Amabile argued that it is not possible to articulate objective criteria for a creative product. Rather, she asserts (1983, p. 31):

> A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated. Thus, creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced.

Amabile (1983) lists necessary conditions and requirements regarding the

creative tasks and methods for successful utilization of the consensual assessment technique. Three requirements must be met in selecting an appropriate task:

(1) the task must result in a clearly observable product or response that can be made available to appropriate judges for assessment;
(2) the task must be open-ended enough to permit flexibility and novelty in response;
(3) the task should not depend heavily on special skills that some individuals may have developed more fully than others.

Amabile (1996) reports – by author, task/product, subjects, and judges used – the results of approximately 53 different studies that utilized the consensual assessment technique for rating creativity in a variety of artistic domains (visual art, poetry, and story telling). Inter-rater reliability scores for the reported studies are consistently high. Several researchers have utilized or tested the CAT in visual art, in poetry and in story writing, also with consistently high inter-rater reliability, supporting the construct validity of this technique.

The CAT has been modified and used successfully by Bangs (1992), Hickey (1995), Daignault (1997), and Brinkman (1999) for rating the creativity of musical compositions, and by Amchin (1996) and Priest (1997, 2001) for rating musical improvisations.

While the CAT assumes that "expert" judges can reliably rate creative products, recent research has examined who the best "experts" might be. Runco, McCarthy, and Svenson (1994) sought to determine which group of judges was most reliable for judging the creativity of visual artwork when using consensual assessment. College-level subjects created three artworks to be self-rated, rated by peers, and rated by professional artists for creativity. The self-assessment rankings and peer assessments rankings for subjects' art works were similar. Professional judges also ranked the drawings, but the differences between rankings were not significant and the scores given by the professionals were much lower than those given by the students.

Hickey (2000) sought to find the best group of judges when using a CAT to rate the creativity of children's music compositions. She compared the reliability of creativity ratings of 10-year-old children's original musical compositions among different groups of judges. The inter-rater reliabilities for each group's creativity ratings were: .04 for composers; .64 for all music teachers combined; .65 for instrumental music teachers; .81 for general/choral teachers; .70 for music theorists; .61 for seventh-grade children; and .50 for second-grade children. Hickey suggested that maybe the best "experts" for judging creativity are not those who are professionals in the field, but those closest to the students who are creating the works (in this case, teachers).

Webster and Hickey (1995) compared the reliability of open-ended ("consensual assessment" type) scales to more closed, criterion-defined scales for

rating children's musical compositions and/or creativity. They discovered that rating scales using consensual assessment as outlined by Amabile were at least as reliable as – if not more reliable than – scales with more specific criterion items (see Figure 6.1).

The CAT provides a method for researchers to identify creative musical compositions of children in a realistic and valid manner. It conforms to the widely held social definition of creativity and supports "small c" creativity. While teachers are not likely to use this method as a form of assessment in their classroom, the premise on which it is based can help teachers understand that "unusual" can be good. In fact, "unusual" might even signify creative potential in a given child. Music research incorporating the CAT also confirms that music teachers do have the ability to correctly identify varying levels of creativity as evidenced in the compositions of children.

6.3 Cantometrics

6.3.1 Background

Because music is a cultural artifact and, as a result, musical creativity must be considered within a cultural context, we turn our attention to a method of

Specific musical characteristics (presence)

Rhythm

- The degree to which the composition shows a pleasing use of rhythm

5 4 3 2 1

Texture

- The degree to which the composition shows a pleasing use of texture (use of more than one instrument or pitch at a time)

5 4 3 2 1

Global considerations

- First impression

5 4 3 2 1

- Imaginative varying and ornamenting

5 4 3 2 1

- In general, the degree to which the composition has aesthetic value

5 4 3 2 1

Figure 6.1 Rating scale samples from Webster and Hickey (1995).

analysis developed specifically for that purpose. In the study of music "as a form of human behavior", Alan Lomax (1962, p. 425; see also Lomax, 1976; Nettl, 1964) has been one of the most prolific researchers in the field of ethnomusicology. He developed the system of "cantometrics", which, using a series of 37 qualitative judgments, "enables a listener to listen to a recorded song from anywhere in the world in a matter of minutes" (Lomax, 1962, pp. 428–429). The 37 scales in Lomax's original list can be grouped into meaningful subcategories, including group organization, level of cohesiveness, rhythmic features, melodic features, dynamic features, ornamentation, and vocal qualities (Lomax, 1976, p. 18). Though compositions by student composers undoubtedly emerge from within a social milieu, some of the more creative examples challenge the rule system, limitations, and constraints imposed by that context. As a result, the application of cantometric analysis to these compositions allows a method of assessment that is not burdened by the assumptions of any single cultural style and does not inherently impose the quality of "good" or "bad" upon a given work. Instead, purely musical traits of the composition – "gross traits rather than the detail of music", according to Lomax (1962, p. 426) – are observed objectively and these ratings are used to compare across compositions. Lomax and an assistant reviewed approximately 400 recordings from 250 different culture areas as a means of testing the viability of cantometrics as a system of analysis (Lomax, 1962). Within the context of the present study, the comparisons were, of course, made across compositions rather than social groups, yet the application of this technique proved highly successful.

6.3.2 The present study

In the experiment that we will be reporting, a subset of 13 scales was used rather than Lomax's complete set of 37. This decision was made due to the fact that many of the scales would not have discriminated the compositions to be evaluated, due to the nature of the assignment. The 13 chosen scales, along with the various categorical values for each, are provided in Table 6.1.[2] For more details about the scales and their application in this analytical context, consult Lipscomb, Hickey, Sebald, and Hodges (2003).

Student compositions analyzed for this study were taken during the fourth week of a 10-week creative music project. Fifth-grade (9- and 10-year-old) students from four music classes ($N = 86$) at Monroe May Elementary School in San Antonio, Texas participated in this study. A grant from Texaco Corporation afforded the opportunity to purchase SoundBlaster Live! sound cards, LabTec LT 835 stereo headphones, and BlasterKey keyboards for each of the 25 computer stations in the lab. The 10-week project consisted of a tonality judgment pre-test, eight weeks of instruction in compositional techniques, and a tonality judgment post-test. Taught by Dr David Sebald (University of Texas at San Antonio), the instructional component of the study focused primarily on musical form, but also introduced other musical

Table 6.1 The 13 cantometric scales used in the present study; selected and modified from the list of 37 used by Lomax (1962). A category of "NA" (not applicable) was added in some cases

(1) Musical organization of instruments (musical texture)
no instrument – monophonic – unison – heterophonic – homophonic – polyphonic
(2) Rhythmic coordination of instruments (blend)
little to none – minimal – good – unison – maximal
(3) Overall rhythmic structure (meter)
free – irregular – one beat – simple – complex
(4) Melodic shape (contour)
NA – arched – terraced – undulating – descending
(5) Musical form
through-composed – repetitive with variation – repetitive without variation – strophic – canonic – other
(6) Phrase length (number of measures)
more than 8 – 5 to 8 – 3 to 4 – 2 – 1
(7) Number of phrases
more than 8 – 5 to 7 – 4 or 8 (symmetrical) – 4 or 8 (asymmetrical) – 3 or 6 (symmetrical) – 3 or 6 (asymmetrical) – 2 (asymmetrical) – 1 or 2 (symmetrical)
(8) Position of final tone
NA – lowest tone – lower half – midpoint – upper half – highest tone
(9) Keyboard range
within P5 – within octave – 1 to 2 octaves – 2 to 3 octaves – >3 octaves
(10) Dominant melodic interval size
NA – monotone – ≤ semitone – whole step – maj/min 3rd – P4 or larger
(11) Polyphonic type
none – drone – isolated chords – parallel chords – harmony – counterpoint
(12) Use of tremolo
little or none – some – much
(13) Use of accent
unaccented – some – main pulses – main beat pattern – most notes

elements as a means of introducing the concept of musical organization (rhythm, meter, tempo, texture, harmony, melodic repetition, contour, etc.). Students were also instructed in the basic use of Cakewalk Express, a MIDI sequencing program, as a means of recording their musical ideas. The present chapter will focus on the cantometric analysis of student compositions collected midway through this instructional process.[3]

Two specific research questions guided this research. First, can typical students learn to create music effectively with the technologies (i.e., computer, sequencing software, MIDI keyboard, etc.) described above? Second, can Lomax's "cantometrics" (1962, 1976) provide a reliable method for analyzing these student compositions? Each investigator independently evaluated the 86 student compositions in two ways: using 13 cantometric scales and on a scale of dissimilarity in reference to a "standard". For the specific composition assignment being evaluated, students were given a repeating

Figure 6.2 The two-measure rhythmic sequence provided to students as a basis for their musical composition.

two-measure percussion beat pattern (Figure 6.2) and were free to incorporate, edit, vary, and/or use this building block in any way they saw fit in the process of creating their composition. For the dissimilarity judgments, the original repeating two-measure rhythmic pattern was used as the standard, affording an opportunity to judge how much a given student composition varied from the material initially provided to each student by the instructor. Inter-rater reliability was very high for both the cantometric scales (r = .82) and the dissimilarity ratings (r = .80).

In the following presentation of cantometric ratings, we will discuss two groups of students: those whose compositions were judged to be "most different" in the dissimilarity rating task and those whose compositions were defined as "more similar" (i.e., less dissimilar). The former group was operationally defined as any individual whose composition received an average rating of 4.5 or greater on the scale of dissimilarity ("1" = most similar; "5" = most dissimilar) in comparison to the standard. Obtaining such an average required that either one or both of the investigators assign a rating of "5". Of the seven compositions included in this category, five were assigned a rating of "most dissimilar" by both investigators, while the remaining two compositions received a rating of "5" from one investigator and "4" from the other. When a cantometric profile was created to compare these two groups – "different" (n = 7) and "more similar" (n = 79) – notable differences emerged. A visual representation of these profiles is provided in Figure 6.3 and a brief verbal description of the most notable differences is provided in Table 6.2. In accordance with Lomax's instructions, the profiles in Figure 6.3 were created by identifying the category within each scale that represented the most frequent occurrence within the group. These "most frequently occurring categories" are then connected by a line from one scale to the next. In the figure, a broken line represents the profile for the "different" group (D), while a solid line represents the profile for the "more similar" group (MS).

As one can instantly perceive from the differential profiles in Figure 6.3, students whose compositions were rated "different" in comparison to the standard appear to have utilized different compositional strategies than the "more similar" group. The most substantial differences are identified in Table 6.2. It is, perhaps, no surprise to find that the greatest number of differences occur in the manner in which melodic features are manipulated.

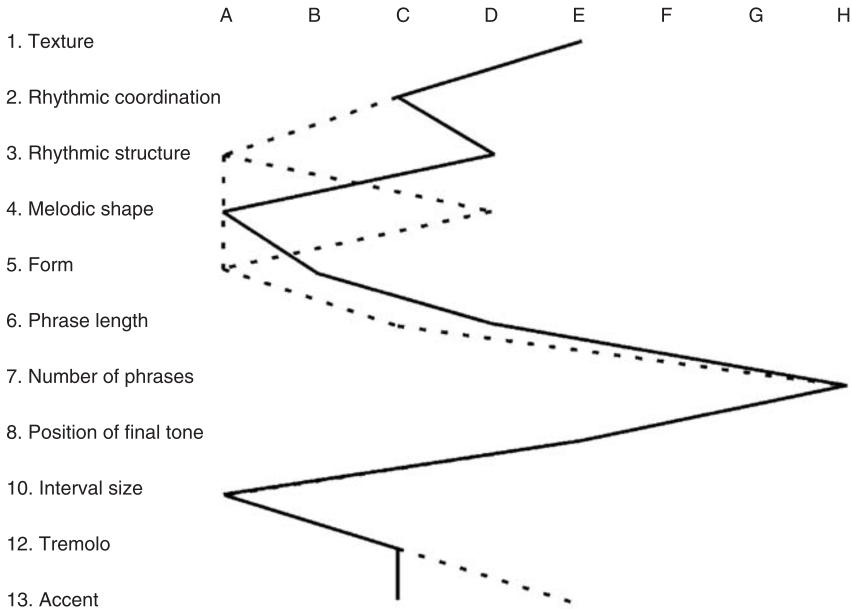

Figure 6.3 Overlaid cantometric profiles for "more different" (broken line) and "more similar" compositions (solid line). The letters (A to H) at the top of the figure refer to the various responses to each given scale provided in Table 6.1. The first potential response is represented by "A", the second by "B", etc. Note that the triangle shape around item 4 (melodic shape) results from the fact that an equal number of the compositions fell into categories A and D.

Rhythmic and dynamic features (e.g., accent)[4] also play an important role in this distinction.

Almost all MS compositions (95%) were identified as "simple" when their rhythmic structure was evaluated. The D compositions revealed a higher degree of complexity and variety: though many of these compositions were also categorized as "simple" (36%), many were assigned to the "free" category (43%). Concerning the presence of accent, the MS compositions were categorized primarily as "medium", described as "conforming to the main beat pattern". Interestingly, very few of the D compositions were assigned to this middle-ground category. Instead, there was significant variability in the way that accents were either present or not: very forceful (accents falling on most notes; 21%), relaxed (some accent; 21%), and very relaxed (nearly unaccented; 43%). It appears that, though a small percentage of students in the D group used forceful accents, this rhythmic aspect of musical composition was subdued in comparison to the MS group.

A large proportion of the MS group (90%) utilized no discernible melody in their composition. This may not be as surprising as it seems at first, given

Table 6.2 Comparison of selected item differences between all compositions and compositions from "most different" group

Item	*"Less different" compositions*	*"Most different" compositions*
(3) Rhythmic structure	Choice D (simple) 95%	Choice A (free) 43%; Choice D (simple) 36%
(4) melodic shape	Choice A (no discernible melody) 90%	Both Choice A (no discernable melody) and Choice D (undulating) 38%
(5) form	Choice B (repetitive with some variation) 43%	Choice A (through-composed) 50%
(6) phrase length	Choice D (short 2 ms.) 64%	Choice C (medium 3–4 milliseconds) 54%
(10) interval size	Choice A (no discernible melody) 90%	Choice A (no discernable melody) 38%; Choice C (1/2 step or less) 31%; Choice F (4ths & 5ths or larger) 15%
(13) accent	Choice C (medium, accents conform to main beat pattern) 57%	Choice A (very forceful) 21%; Choice D (relaxed) 21%; Choice E (very relaxed) 43%

that the template provided to each student contained only a basic drum rhythm and bass line. The addition of a melodic component required a creative leap on the part of the student composer. A substantial group of the D group compositions (38%) were also evaluated in this same category. However, an equal number of compositions (38%) were categorized as "undulating", meaning that not only did these students add a melody to their composition, but they also created a coherent up-and-down melodic contour. The dominant melodic interval also revealed a significant difference between the groups. Though the same percentages were categorized as "no discernible melody" (90% for MS and 38% for D), the D group revealed a greater range of variability. In fact, 31 per cent of these compositions used a dominant interval size of a half step or less, resulting in a highly chromatic melodic context. Another small but significant proportion (15%) utilized mostly perfect fourths and fifths.

When considering overall musical form, compositions in the MS group tended to fall into the "repetitive with some variation" category (43%), an organizational structure familiar to all students from the many familiar folk melodies and daily listening to popular music forms. In dramatic contrast, 50 per cent of the D group submitted compositions that were categorized as "through-composed". Phrase lengths also differed between the two groups. Compositions by the MS group consisted of short two-measure phrases (64%), while the majority of D compositions exhibited phrases that were three to four measures in length (54%).

In conclusion, the use of cantometrics as an evaluative tool allowed us to determine that the compositions considered "most different" from the standard template provided by the instructor evidence certain musical traits that distinguish them from the compositions that are "more similar" to the standard. Specific musical characteristics that differentiate these groups of compositions include:

- freer rhythmic structure;
- examples of heavily accented and nearly unaccented compositions, rather than the middle-ground use of accent evidenced in compositions of the MS group;
- the innovative addition of an undulating melodic contour to the rhythmic underpinning provided by the musical template;
- the dominant use of small (semitone) and large (perfect fourths and fifths) melodic intervals;
- through-composed musical forms, rather than thematic variation
- longer phrase lengths.

6.4 Further research

The study reported above opens the door to a wide range of research possibilities. Lomax's cantometric system has proven quite useful in determining perception-based differentiation between student compositions. More research is needed to determine its viability and additional contexts within which it may prove of use.

Further research is needed to continue to examine the validity of the CAT, and to compare it to Webster's MCTM. In addition there is a need to examine the connection between the process of children's creative musical thinking and the creative success of their final compositions in order to help teachers encourage this success in their classrooms. How might either the CAT or Webster's MCTM be used to view this connection between process and product?

Finally, it is worth noting that the goal of this research was *not* to evaluate student compositions in regard to some standard of "quality". Instead, we wanted to identify specific differences between student compositions for use as a means of considering the various ways in which students approach such a creative task. Quality – whatever that might mean in the context of student compositions – remains, as yet, unmeasured.

6.5 Conclusions

Two questions were posed at the beginning of this chapter: How can we facilitate student learning and creative use of both the worlds of rule-bound composing and free creativity? What means can we utilize to determine when a child has acquired the ability to combine these worlds? By identifying and

then examining a group of children's compositions using the cantometric lens created by Lomax, we were able to identify those most "different", and delineate the characteristics of these compositions. We hope by understanding that different *can* be good (and easily identified) that teachers will support and even encourage compositions that use free rhythmic structure, through-composed musical forms, innovative melodic use, and longer phrase lengths to a greater extent than might be typical or expected for elementary-grade children. Composition assignments should be balanced between structure and freedom in order to facilitate children's growth in free creative thinking. We need to be sensitive to the unique compositions that are created by children and not dismiss them immediately as "wrong", but rather embrace the thinking that challenges the norm.

What constitutes a *good* composition? What constitutes a *creative* composition? Where does "highly unusual" fit in? Can different be good? How can good be different? The present authors believe that different *is* good, and good *is* different when it comes to children's compositions. If as teachers we want to *encourage* creativity, then we should support and promote that which might be perceived as "different". While it is certainly true that rules, theory, and basic musical skills form an important part of music instruction, it is important for teachers to realize that compositions that sound "different" do not necessarily constitute "bad" music. This realization will allow students to produce truly creative work – even that which is conceived as extreme – and will not act to censor students whose creative output is "different" from the norm. It is quite possible that such an individual has provided evidence of unusual creative potential. In order to capture such creative potential, in fact, it may prove useful at times to evaluate as "positive" not how closely the results of a student's creative effort fit within the confines of a guided assignment, but how far beyond the boundaries the student can go while still producing a unique, yet coherent, creation.

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Notes

1 MIDI stands for Musical Instrument Digital Interface and is the standard file format that is created using a digital instrument such as a synthesizer/keyboard and music sequencing or notation software.

2 For a complete list of Lomax's 37 scales in their original form and examples of completed coding sheets, see Lomax (1962, especially pp. 429–431).

3 Results of the tonality experiment have been reported elsewhere (Hodges & Lipscomb, 2004; Lipscomb & Hodges, 2002).

4 Though Lomax places the "accent" scale in the "Vocal Qualities" category, in the context of the present study, the present authors believe it belongs in the "Dynamic Features" category due to both the basic tenets of the Western musical tradition and the manner in which this scale was rated within this analytical context.

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7 Understanding children's meaning-making as composers

Pamela Burnard

7.1 Introduction

Research into music composition by children and children composing was a springboard to further understanding of children's musical development (Hargreaves, 1989). It is not surprising that foci of research in the 1980s and 1990s became rooted in children's compositional development (Kratus, 1985, 1989; Swanwick & Tillman, 1986), quantitative measurement of and psychometric work on creative thinking in music (Hickey, 1995, 2000, 2001; Webster, 1987, 1990, 1992), and assessment rating of creativity in children's music compositions (Auh, 1997; Hickey, 1995, 1997, 2000, 2001, 2002a; Webster, 1994; Webster & Hickey, 1995). Of the major developments since, the identification of differing but relevant characteristics include researching: children's compositional products (Barrett, 1996; Loane, 1984); children's compositional processes and products (Barrett, 1998; Kratus, 1994, 2001; Levi, 1991); mapping children's compositional approaches, strategies, and pathways (Burnard & Younker, 2002; Daignault, 1997; Kratus, 1991; Wiggins, 1992, 1994; Wilson & Wales, 1995; Younker, 2000; Younker & Burnard, 2004); children composing with computers (Folkestad, 1996; Folkestad, Hargreaves, & Lindström, 1998; Mellor, 2002; Seddon & O'Neill, 2001); and children's collaborative compositions (MacDonald & Miell, 2000; Morgan, Hargreaves, & Joiner, 1997/8).

With the development of social psychology and sociocultural theories, underscored by the importance of studying children in context (Graue and Walsh, 1998), researching children composing has become more comprehensive, shifting from positivist, large-scale studies aiming to measure creativity in children's composition towards ethnographic, qualitative approaches, and to research focusing on the actual site of operations and practice (Hickey, 2002b, 2003). At the same time, these methodologies for investing in children's composition and composing in education reflect a major line of debate in music educational research, with many tensions between the findings of research conducted in naturalistic and more contrived settings. To this end, this chapter responds to an apparent disjunction between, on the one hand, cognition-centred, universal law-making studies, conducted in a

laboratory-like institutional setting, where children are disconnected from their world and are required to operate in isolation, independent of culture and context and, on the other hand, where the experience arises in some way particular to each child's world: for example, where an experience is realised through interaction and with immediate frame of reference to other mutually engaged, situated children (see discussion in Barrett, 2001, 2003; Espeland, 2003; Young, 2003).

Although in recent years the scope of empirical research has broadened from research *on* children to research *with* children, less research attention appears to be paid to children's views, perspectives and accounts of the processes and products of compositional activity. The neglect of the child's perspective has been highlighted and criticised by, among others, Barrett (2001), whose call for more attention "to be paid to the child's voice in musical experience" (p. 43) echoes Young (1998/9), who advocates developing context-sensitive methodological frames for researching "the child's way of being musical which is intimately connected to context and is not something which can be discretely isolated for study and captured in a series of sounds" (p. 16). Research interest in eliciting and authorising children's perspectives focuses on what can be learned from not only closely observing children but also listening to (and for) children constructing and communicating their own musical meanings (Barrett, 2001, 2003; Burnard, 1999, 2000a, 2000b, 2001; Carlin, 1998; Christensen, 1993; Glover, 1990, 1999, 2000; Gromko, 1994, 2003; Stauffer, 1998, 2003; Wiggins, 2003).

The substantive focus of this chapter comprises the shift in research paradigms that allows for contextual and situated understandings. The chapter begins with a thematic review of the existing literature that enquires into the complexities of children composing and the processes through which children come to "make sense" of composing in particular social and cultural situations on the basis of meanings. This is followed by four case-study stories of children's meaning-making as composers in the context of an informal setting. A more complete account of the research design, method, analysis and results is offered elsewhere (Burnard, 1999, 2000a, 2000b, 2002b).

In educational settings that connect the particular to its context, studies range from children composing in playgrounds, in pre-schools and kindergarten classrooms, where children's engagement in activities is voluntary (in conditions that are neither unfamiliar or artificial), through to the school classroom as a site of cultural complexity and situated practice, where children's engagement is seen as a relational, situational, and social phenomenon. This marks a broadening of the perspectives and paradigms from which researchers operate (Espeland, 2003).

Among the researchers who advocate children's compositions as a distinct genre (Blacking, 1967; Marsh, 1995, 2000; Moorhead & Pond, 1941, 1942, 1978; Pond, 1981; Shehan Campbell, 1991, 1998; Sundin, 1998), Glover (2000) argues that "young children's music [has] its own characteristic features and [is] not simply . . . a pale or incompetent imitation of the adult

world around them" (p. 49). Common to investigations of children composing where the children's views are not overlooked, and where the fundamental orientation sees data generated in educational contexts as social activity (rather than collected to test a hypothesis using individualistically oriented approaches), is the explicit assumption that the *creativity* of the child operates within a framework that is qualitatively different from that of adults and acknowledges the need not only to understand what happens (product) and how it happens (process), but also to listen to what children say and think about composing, rather than assume we know.

If we accept that the potential value of contextual studies in educational settings lies in the belief that children "act" on the basis of meanings and understanding, then empirical approaches that honour the multiple perspectives and multivoicedness of children as composers, as Shehan Campbell (2002b, p. 192) suggests, deserve "prominent consideration in the enterprise of research in music education".

Theoretical orientations of this chapter move between constructivism (Bruner, 1990), hermeneutic–phenomenological inquiry (Husserl, 1970; Van Manen, 1990), and sociocultural mediated action (Wertsch, 1991) as theoretical frames from which to examine the *particular* meaning of this child, in this situated context, with this action and this child's voice as it arises within this socially and culturally mediated context. Apart from how children reflect on the experience and ascribe meaning to composing, there are further considerations in the particular way the "child" is viewed in context-specific and context-sensitive settings. If the teacher or researcher is, as is commonly the case, the only participant in the context who claims to assume the role of an expert (composer), it may be central to consider to what extent being a composer becomes (increasingly) possible for children, as well as whether meaning is constructed *for* the children as well. The other side of this question is obviously the role constructed for the researcher and/or teacher and the way "composing" is defined differently in situated practices such as playgrounds, nurseries and classrooms. For it is these underlying assumptions and theoretical positionings that: (1) serve to frame different research agendas with children; (2) constitute the appropriate method for doing so; and (3) connect our work (or not) to that of others.

7.2 Constructing understanding in nurseries and playgrounds

Originating from the seminal methods of observation of early childhood musical activity (see Moog, 1976; Moorhead & Pond, 1941, 1942; Pond, 1981; Sundin, 1998), whose analytic techniques were sensitive to context and to the temporal development of shared meanings, several researchers have gone on to develop methods of observational analysis with the use of interpretive frames that make use of ethnographic approaches and videographic processes for the study of children's musical cultures (Addo, 1997; Blacking, 1967), children's musical gestures (Cohen, 1980), children's joint

play activity (Littleton, 1991), children with the supportive intervention of adults as musical mediators (Custodero, 1997; Young, 1998/9), the innovative use of conversations in the playground (Marsh, 1995, 2000; Shehan Campbell, 1991, 1998, 2002a), and "talk-in-interaction" as a process of active interviewing while children generate notations and notions about their own compositions (Barrett, 2001, 2003; Gromko, 1994, 2003).

What is common to these studies conducted in natural settings is that, from the very youngest of ages, the embodiment of children's personalised and particular musical creativity evolves through the music young children make for themselves. In play or free choice settings, from song making to music created on instruments, what is salient to their musical experience is the individual meaning-making and meaning-using processes that connect them to their culture (Bruner, 1990). Young children's musical creations are purposeful and intentional. They are reflective of the young child's world from within which the particular child brings all previous musical experience, and a wider understanding of what music is, to create music in particular ways, on and of their own.

Another research arena, in which researchers highlight most powerfully and give voice to young children's own awareness of the processes involved, is the musical environment of the playground (Addo, 1997; Marsh, 1995; Shehan Campbell, 1991, 1998, 2002a). In this context, what is commonly reported is the qualities of clearly identifiable, preserved music, effortlessly negotiated in highly sophisticated ways, where what is learnt, how it is learnt, and what counts as composing are inherently culturally and contextually specific.

7.3 Constructing understanding in school settings

The importance of sociocultural situatedness and contextual perspective is implicit in the groundbreaking work of Glover (1990, 1999, 2000), who, among other studies, tracked the compositional work of 100 children aged between seven and eleven years. Within a multiethnic city junior school, an empty classroom was made freely available for the children so they could pursue their own musical purposes, intentions, tools, resources, and ideas within a particular time. The context was fluid and dynamic. Glover drew up a list of the different categories of children's statements about *what* and *why* various compositional decisions were made (often articulated as purposes) and that children seemed to adopt as a basis for their musical activities. These ranged from "just playing", manifest as singing and playing for its own sake, to "making some music", to "songs I make". No statistical techniques were applied to check the relationship between the most frequently occurring categories and types of compositions. However, again what is common when children compose, and where language is used to share and develop meaning, as constructed by different groups, is how composing involves a personal investment, a certain giving of oneself, and how children give themselves over

to the encounter with what is being composed. They relish opportunities to reflect on their compositional experiences and engage in *intentional activity* in which the issues of form and structure, reflection and revision of ideas are often central. Further, in being willing to be personally affected by their own composing, facets of their own identity as a composer are brought into question.

These findings concur with Mellor (2000), Barrett (1996), and Davies (1992), who found that children as young as five can appraise their own compositions, construct their own understanding of composing, and approach composing as composers (for example, have the courage of one's musical convictions, persevere, take musical risks, face consequences, be constructively and musically self-critical, and be the originator of judgements concerning the meaning and value of what one is composing), when given time, space, resources, and choice in opportunity.

Children's experience and meaning-making as composers are neither separate from nor independent of the compositional context in which they find or place themselves. This is one of the fundamental tenets of the sociocultural perspective, as pronounced and shared in the work, among others, of Sundin (1998), Folkestad (1996), Espeland (2003), and Barrett (2003). Each of these authors, both empirically and theoretically, frames ways for rethinking children's musical composition and composing. Each challenges the dominant explanation of children's compositional development. According to Espeland (2003), schools offer a model for understanding communities of practice where "contextual elements create" (p. 189) certain kinds of group and individual compositional and composing experiences. Espeland supports the argument for the sociocultural situatedness of children composing with a call to refocus research lenses on what the children are doing, where, with whom they are doing it, and when they serve as environments for each other. In this, he invites us to investigate further the socially constructed positions that serve as contexts for children's relations with others when composing in school classrooms.

Further studies conducted in school classrooms that have drawn attention to and provided evidence of children's own position in, and experiences of, composing, and their engagement as co-composers, underpinned by constructivist perspectives, has been conducted by a small number of music teacher-researchers who provide valuable evidenced-based and theorised practice (DeLorenzo, 1989; Wiggins, 1992, 1994, 2003; Younker, 2003). Each reminds us how children's participation in classroom settings plays out multiple roles and makes musical thinking more visible. Children's capacity for personal investment corroborates researchers of individual children composing (see Barrett, 1996; Davies, 1992), who argue (often against the findings of cognitive researchers) that children at this age are capable of constructing understanding as composers.

In a continuing effort to understand the detailed ways in which the role of power relations in group composition influences participation and the nature

of group leadership in class compositions, researchers have investigated the ways in which "each momentary" act or "significant compositional event" underpins the making of classroom-based group compositions (Espeland, 1994, 2003; Loane, 1984). Others have reported on how the social factor of friendship and friendship groupings among children positively assists in the production of compositions (Burland & Davidson, 2001; MacDonald & Miell, 2000; Morgan *et al.*, 1997/8). What is common to all of these studies is that composing in classrooms occurs within communities in which "the practice" of composing evolves through children's mediated actions in a compositional process and in the way they interrelate with contextual elements. Clearly, the basis for constructing and communicating meaning, and in compositional experience, is how children themselves assign importance to these factors.

Clear landmarks in researching children composing in schools have come through the analysis of language used by pupils in the appraisal of their own compositions (Auker, 1991; Mellor, 2000). Giving pupils a voice or more of a say about teaching and learning, through consulting them, is enjoying a growing currency in educational research, in part because it has come as a response to a changing social climate in which children are less willing to be taken for granted. It stems also from the initiative taken by schools (and researchers) to test the waters and discover that children are generous commentators and insightful as to what and how they think (Rudduck & Flutter, 2000).

7.4 Constructing understanding in informal settings

The context of composing can be defined phenomenologically as the situation: not only the activity itself, but also the environment and those within the environment (Husserl, 1970). How the activity is experienced will depend on the whole context and the contextual elements that are mutually constituted and situated. What follows is a series of case studies that reflect *how* composing was experienced and *what* composing came to mean to members of a group of 12-year-old children who, as members of a weekly lunchtime "Music Creators" Soundings Club, were watched, listened to, and invited to reflect on their own understanding.

Every Friday for six months, members of the club, all of whom knew each other, converged on a music room in an experiential situation or context distinct from the normal classroom. Here, there was no teacher present, no instruction, and no constraints of curriculum, tasks, or assessment. The researcher was present as an ethnographer whose position within the school was as a frequent visitor. She did not fit the more familiar role of teacher, but rather adopted a flexible stance in the role of a participant observer (Hennessey & Amabile, 1988), who acted as an agent for reflection (Atkinson & Hammersley, 1994) in a setting that was relational and salient to the children and the children's relations to each other.

One of the techniques employed for understanding children's meanings was the use of *image-based research*. While the uses of image-based research generally remain undervalued and underapplied (Prosser, 1998), a growing number of researchers are making innovative use of drawings in research with children (Bamberger, 1982; Barrett, 2001; Burnard, 2000b; Christensen, 1993; Christensen & James, 2000; Davidson & Scripp, 1988; Elkoshi, 2002; Gromko, 1994; Upitis, 1992), as a method for gaining access and insight into composing itself, as it appears to children.

In this study, which analysed both the processes and the products of compositional (and improvisational) activity in conjunction with children's verbal accounts of the processes and products, children's drawn images were used not simply as descriptions or accounts of the experience, but as drawn representations of meanings ascribed by the children to the phenomenon of composing (Burnard, 1999, 2000a, 2000b, 2001).

The slice of this research reported in this chapter concerns what we can learn when focusing a phenomenological lens on children's descriptions and drawn representations of the *lived experience* of composing. What follows are exemplars of a sample of children's accounts of composing, arising in a lunchtime club setting where individuals – as the unit of analysis – were active agents that involved other children engaged in compositional activity together.

7.5 Background to the study

The four case studies, each drawn from the larger study of eighteen 12-year-old children, each participated in 21 weekly hour-long lunchtime club sessions for "Music Creators". The fieldwork divided into Early, Middle and Late Phases. Each phase comprised seven sessions (see Figure 7.1 for an overview of the research design). Although ethnographic strategies formed the basis of the fieldwork, phenomenological methods of conducting interviews, and strategies intended to facilitate reflection, were applied (Bresler, 1996). Data collection techniques included: (1) observation of the participants engaged in music making with the researcher in the role of participant observer; (2) semistructured interviews with participants that included an elicitation tool based on personal construct psychology called "Musical Rivers of Experience" and image-based techniques (see Burnard, 2000a); (3) the examination of artefacts. The participants were interviewed both individually and in focus group sessions across the phases of the study.

The use of video for recording observations provided the opportunity to freeze, scrutinise, and capture behavioural nuances (Adler & Adler, 1994), to facilitate video-stimulated retrospective accounts (Lincoln & Guba, 1985) and focus group interviews (Stewart & Shamdasani, 1990). Notated versions involving analysis of recorded compositions were used to free experiential material (Sloboda & Parker, 1985) for relating experiential qualities (things said) with musical analysis (what was done). (A full discussion of the research

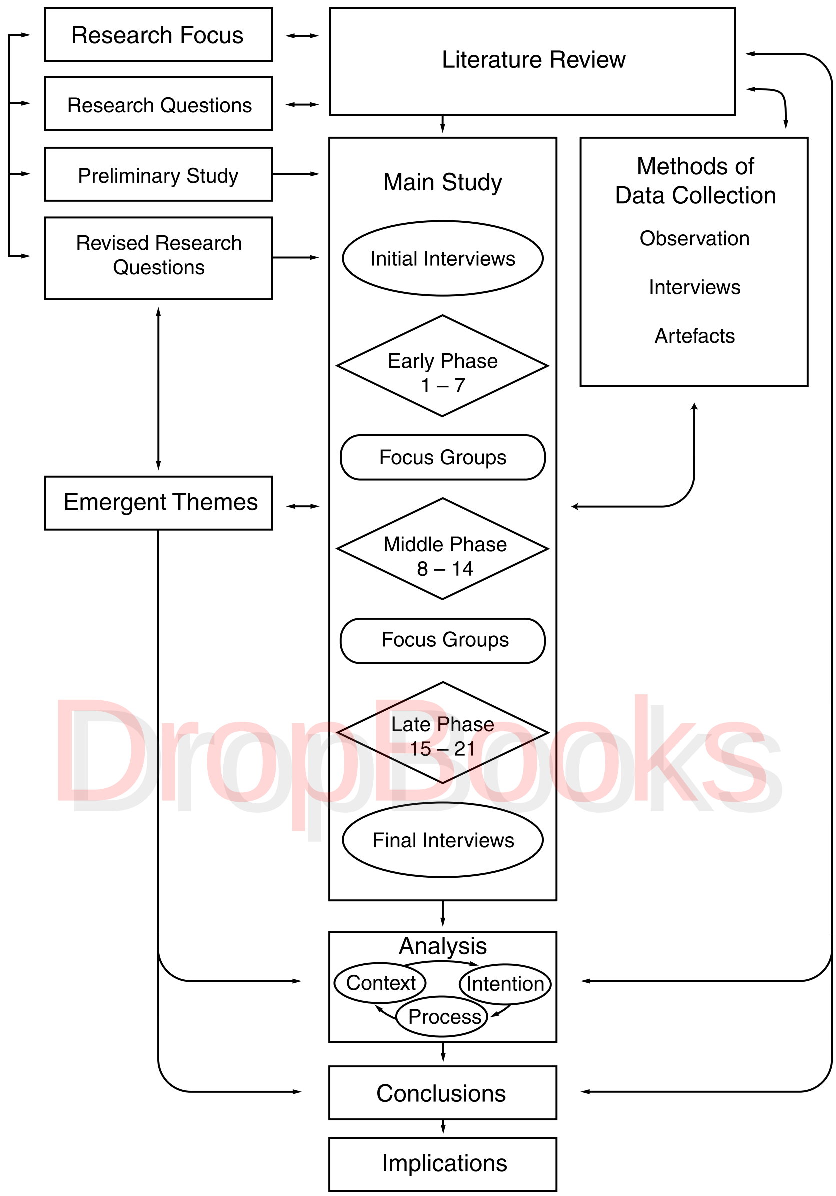


Figure 7.1 The research design.

framework and interview methodology is given by Burnard, 1999, 2000a, 2000b, 2002b.)

The research design was nested within the parameters of an interpretive–constructivist paradigm underpinned by a hermeneutic phenomenological perspective as a descriptive analytical focus.

7.6 The analysis procedure

The cumulative nature of the study meant that the different phases of data collection could be analysed separately and incorporated a number of approaches that included the use of thematic analysis procedures and the constant comparison method (Glaser & Strauss, 1967). The analytical approach involved the segmentation of data, searching for patterns and the development of conceptual categories pertaining to each segment of data for comparison with other similarly coded segments and a process of systematic sifting and comparison (Hammersley & Atkinson, 1983) (see Figure 7.2 for a flow chart of the data analysis process). Specifically, this task involved analysing the final interview comprising 18 hours of talk coupled with the data from 18 individual interviews, 12 focus groups and 21 videotaped sessions. A total of 195 performance events were recorded.

The analysis of the final interviews included a wide range of phenomenological descriptions of the intentional acts of children's consciousness (or conscious awareness). Here, *intentionality* means that all consciousness is consciousness of something. It is oriented, at all points, to the world with which it is in contact (Merleau-Ponty, 1962).

The working procedure specific to the analysis of the final interviews involved a hermeneutic phenomenological approach to the phenomena of composing (and improvising, which is reported elsewhere; see Burnard, 2000a, 2000b, 2002a). The idea of a narrative description or dialogue, which reflects on the experience of the phenomena by those who experience them and the researcher, was described by van Manen (1990, pp. 26–27) in this way:

> Phenomenological text is descriptive in the sense that it names something. And in this naming it points to something and it aims at letting something show itself. And phenomenological text is interpretive in the sense that it mediates. Etymologically "interpretation" means explaining in the sense of mediating between two parties. It mediates between interpreted meanings and the thing toward which the interpretation points.

The procedure adopted was to subject the data to a method of iterative inductive coding, as described in many standard texts on qualitative methods (Glaser & Strauss, 1967; van Manen, 1990). The process of thematic analysis involved a continuous interplay between observations of actions, musical outcomes (drawing on the use of transcriptions) *and* children's talk. The key

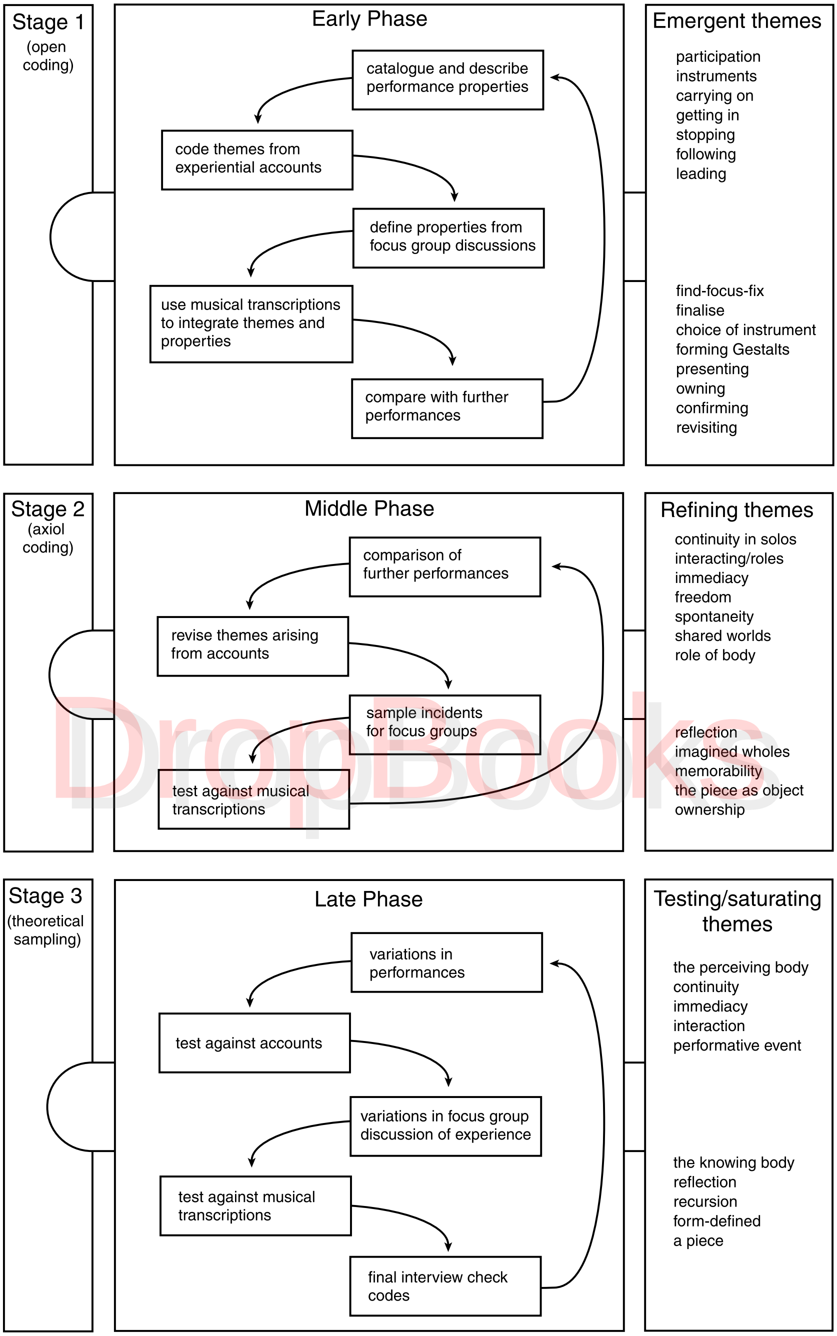


Figure 7.2 The analysis process model.

components of the experience, however, were communicated in-session (from discussion and reflection on action) and out-of-session (interviews using video-stimulated recall). This provided a framework on which to base the phenomenological approach utilised in the final interviews: data to which we now turn.

7.7 The multivoicedness of children as composers

It was found that the children composed in qualitatively different ways. Of the eighteen participants, four illustrative cases are presented. As evidenced from observation and analysis of compositions, composition was thematised as:

(1) a time-based piece;
(2) the integration of action and thought;
(3) a formative or form-defining act.

However, as seen elsewhere (Barrett, 2003; Espeland, 2003), the diversity and complexity of the composing experience is more salient when children are focused on their own perceptions of the experience of composing. These phenomenological accounts, drawn from the final interviews that took about one hour, resulted in over 100 pages of material that informed the researcher about the significant events of composing, the individual and socially imposed rules of engagement, aspects of their creative functioning, and their perceptions relating to the making of their own meanings and the meanings of their own musical worlds as composers. The findings show that the children who composed individually, had their own instrument, and were accustomed to routine practice schedules spent from 30 minutes to three hours composing their own music each week. Paired or trio collaborations resulted in the players spending extended periods of out-of-session time working together to the extent of regular sleepovers or recruiting a new member as a performance facilitator. For these children, the compositional experience seemed to be defined by the temporal parameters ("having time to think"). This meant that time became a function of the act itself, as seen in the following cases.

7.7.1 Case 1: Introducing an individual composer who composes "proper pieces"

Tim (a 12-year-old) had completed five years of formal instrumental tuition on piano and reached Grade 5 in piano, Grade 4 in theory and Grade 3 in violin. For Tim, composing meant "playing around" until he "found a chord" he liked and began "working with it". He would then assign a chord as a signpost "to mark the point where I return to the first section". Then he would "fix" these "bits" into sections. This involved "fixing" what was good and "marking it out" into sections and "binning the bits that weren't good or

were too hard to play or remember”. For remembering the order of each section, he used a strategy of signposting certain time points that “mark the end of each section”. The strategy of envisioning “sections” allowed him to move around and back and forth, playing through and thinking “back to the beginning idea”. The process involved the construction of a frame that evolved as the piece was built up and assembled in bits. As Tim metaphorically suggests, “it’s something like when you do a puzzle, you do a bit and you can’t do anymore so you go away and then you come back and you’ve found some more ideas for fixing and finalising”. Tim committed these “proper pieces” to memory using a recursive pathway that involved looking back, orbiting around, and moving back and forth between phases of exploration (“finding”), selection (“focusing”), aural testing (“fixing”), revision and editing (“finalising”) on evolving drafts in musical memory.

7.7.2 Case 2: Introducing an individual composer who composes “quick pieces”

Lia (a 12-year-old) had played the guitar since the age of seven. When Lia “made her own pieces” they were always on guitar. She’d spend most of her time “mucking around with ideas”. Unlike Tim, Lia was less inclined to revise or select ideas for reworking. Instead, composing was directly linked to her love of performing and the having of and playing with ideas. All of her compositions were referred to as “pieces I play”, as is illustrated in the following comments: “For me, a made-up piece is just like . . . a quick piece you like to play now” and often did in front of friends and family. “You can even make mistakes and you just gear up and include them . . . Whenever you play it again, it comes out different anyway so it’s never really the same thing or set in your memory”. Her intention was to make pieces afresh. Ideas were edited to what was playable (i.e., through bodily action) and memorable (i.e., as ideas revisited). “You just put your mind to it . . . by mucking around with some ideas you find from things you know . . . it’s a musical search . . . I like to reuse ideas . . . then you anchor these ideas while you play through without stopping”. Lia intentionally composed “quick pieces”. She moved between sensory and motor processes in a way she described as being “like an intersection” where “ideas come from all directions and from different places”. She would “find” and “anchor” musical ideas representing both sensory-directed patterns and patterns of bodily action: the actions of a body well-attuned to its needs, goals and interests rendered possible from a body’s interaction with an experience-shaping “musical search”. There were moments of sensory immersion “in my own world” while at other moments her bodily hardware, whether innate or acquired, “would go a little bit crazy and do whatever comes out first”. Lia emphasised the role of body and action specific to “being a guitarist” in which the relation between sound and body was evident, embedded in and constituted in her constructed meaning of “quick pieces”.

7.7.3 Case 3: Introducing co-composers of "pieces you don't play and forget"

Of the eight pairs of players who exclusively co-constructed pieces, Chloe (a pianist and flautist) and Sorcha (a pianist) similarly considered friendship a pairing to enable them to extend their individual capabilities as well as offer some protection from the judgement of others. For Chloe, the value of collaboration was emphasised in her commentary about co-composing several six-to-ten minute pieces, one of which was called "The Life Cycle of a Flower". She said: "Our pieces were made and played together . . . when we performed it sounded like an actual piece. It's not like you're in music where you must have this and this and this. We could do what we wanted and it was ours. It's because it wasn't like a little piece that you play and forget, it was like doing our best stuff in it. It wasn't like 'we better do this and that' because it's easy". For them, composing a piece gave them the exclusive right to play their own music whereupon each piece became endowed with a meaning that was understood in relation to children's musical purposes and involved an exclusive collaborative partnership in the making of "a piece we play". This was made possible by assembling sections according to a form-defined plan that was decided prior to starting work on the piece. "I really enjoyed having all that time, like all day, to work on it . . . It was like the biggest thing I've done, except for doing exams and playing flute and stuff. It got the best of both of us . . . This really was my piece." The pursuit of memorability and playability meant that "playing it again and again is different to playing it just once". Similarly for Maria (a pianist), always partnered with Sidin (who had no formal training or instruments at home), the boundary between imagining and forming wholes meant: "I figure out a couple of ideas first. Then I play them and Sidin makes something up and then we stop and talk. We keep starting and stopping and then going back over and over parts and then playing the whole thing through loads of times". The planning is made explicit by a process Sidin described as "confirming" whereby they played and then deliberately stopped in order to share with each other feedback on the worthiness of an idea. As a revisionist strategy, "confirming" appeared to be central to the socially mediated meanings of collaborative compositional actions.

7.7.4 Case 4: Introducing co-composers of reauthored and remixed known songs

For some children, the arrangement and interpretation appear to be indistinguishable and yet the relation to composition was evident in the collaboration of three boys (Ashton, a drummer; Adrian, a trombonist; and Dion, a saxophonist) who deliberately reworked and reassembled versions of an existing pop song called "I believe I can fly". The first presentation of the song was introduced by Adrian, who said: "We know the song and we've put

it together. We've changed some bits though". In the next session the song was rearranged to incorporate a third voice, plus congas and a dance routine. The next presentation involved a remix. Each successive version was reworked, reauthored and presented anew. None of these performances highlighted aspects of the adult model that relates composition as a process involving planning, use of sketches (Sloboda, 1985), and other stage-based notions (Wallas, 1926) or as an original product separated in time from performance, or an exactly specified product. These reauthoring experiences of "our piece", as described by Dion, showed deliberate manipulation and arrangement of musical elements of a known song that they all identified with, owned and could perform confidently. This was a song that saw these collaborators orient themselves to that which they felt was theirs to keep. Adrian related the journey along the way to each performance as "feeling pretty low . . . go[ing] really high . . . going back up and down . . . before you go, go, go, up and up". Adrian describes the peaks and troughs of his journey as a portrayal reflective of a creative struggle often associated with the compositional process, an experience he knowingly claimed to share with Beethoven!

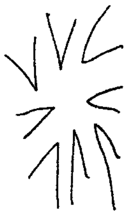
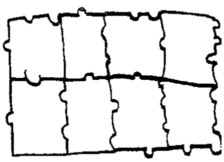
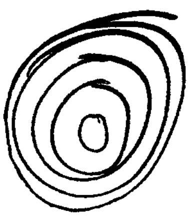
7.7.5 Summary

What follows is a summary of the significance of what children think composing is and some of the ways in which children ascribe meaning differently – as differences conveyed through the use of an image-based research tool called *talk-and-draw*, utilised during the final interview. Here, I invited the children to think back over their experiences of composing over six months and draw an image to convey what it is to compose and to tell me about what they had drawn (see Burnard, 2000b, 2004). Table 7.1 shows a small sample and summary of children's meanings most characteristically conveyed and explored through drawn metaphorical descriptions.

What these drawn metaphors suggest about composing is that meaning is multidimensional and multilayered. In the course of describing and explaining how they composed, the children made descriptions and explanations that served to constitute their views on composing, underscored by their assumptions about themselves as composers, as particular perspectives arising out of the musical community of which they were a member. In recognising and synthesising these complexities, a consolidated thematic overview is offered (Figure 7.3), which attempts to permit comparison and contrast of children's experiential meanings – as characterised phenomenologically into temporal, spatial, relational and bodily themes.

For these children, composing was essentially a meaning-making activity. It was constructed and negotiated between them, as participants within a community called "The Creators Club". This involved an interplay between their intentions underlying the creating process to create *time*-tested, time-based, time-bound and time-free activity with pieces ranging from those that

Table 7.1 Summary and sample of "talk-and-draw" accounts in which children's meanings as composers were constructed

Children's drawing	*Symbolic meaning*	*Children's perspectives*	*Situated qualities of composing*
	Composing as an intersection	*A musical search . . . to reuse ideas . . . then anchor ideas while you play through without stopping*	Ideas meet; can collide (a process of retelling; a playing through; a deliberate salvaging and anchoring of ideas; time-setting)
	Composing as a jigsaw puzzle	*When it fits together to make a proper piece*	Recursive (a constructive process; use of cued elicitations, looking back, orbiting around; time-mapping)
	Composing as circular	*We make something up and then we stop and talk . . . keep starting and stopping . . . confirming . . . going back over and over*	Revisionist (a joint remembering; circular and relational "confirming" becomes a feedback, reinforcing device; time-testing)
	Composing as cumulative	*Feeling pretty low . . . feeling really high . . . musically up and down . . . before you go, go, go, go and finish it!*	Dialogic and dialectical (reauthored and remixed pieces; building on ideas; time-advancing)

were relived "over and over" in order to make a "proper" piece to ones "you don't play and forget".

Composing depended on the "knowing" *body* to draw upon prior experience and knowledge as tools for reflecting within a time frame where the past was experienced as achievement. Rules for creating and acting together (of pieces newly created, recreated anew, or reauthored during performance)

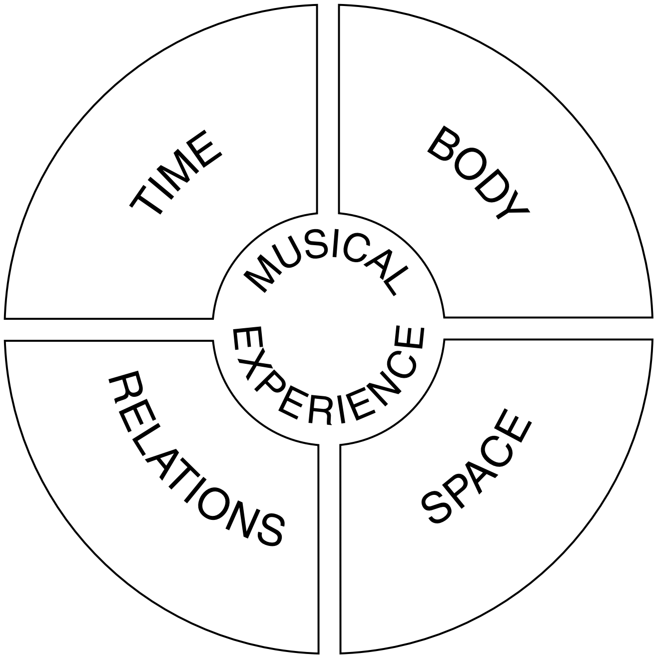


Figure 7.3 The lived experience of children as composers.

were broadly understood not only as formal and explicit, but also as unwritten or tacit routines for "anchoring" or "confirming" the worthiness of ideas. The role of rehearsal or "playing back over" as a reflective, recursive process was a common aspect in time-bound and time-tested pieces, constructed in collaboration with others or individually with others in mind. The use of feedback was a common characteristic of collaborative compositional settings to articulate their developing ideas. The composing process did not follow a straight path but rather took a more cyclical or recursive shape based on assembling parts to form a structured whole.

The children played out a range of *relations* with compositions in ways that demonstrated a strong correlation between the degree of structuring of a composition and the identity attributed to it. For example, there was an "ideas piece", a "quick piece", a "proper piece", a piece "you don't just play and forget", and an "actual piece". Often the *raison d'être* of composing was to create an identifiable piece that required the child(ren) to critically and consciously create an intended object. The compositional map often contained definitive structural signposts that acted as temporal markers to facilitate memory. Thus, the lived *space* of composing a piece was in a sense an object of involvement that was defined as an artifact of their musical biography or past experience.

7.8 Returning to the question of context

I began this chapter by saying that an important question, and perhaps the real dichotomy, posited by contexts of naturalistic and contrived settings is whether experimental designs elicit compositional acts and meanings from the solitary child equivalent to those engaged in by children in natural settings. To this end, we need further studies conducted within contexts that deal with the situated qualities of children composing that can properly take account of composing as a communicative, constructive process, in situations that are not rarefied or artificial. The conduct of research in isolation from the complexity of natural environments can result in a gap between psychological research and educational practice (Hargreaves, 1989); such a dialectical view of theory and practice is not new to educational research (Hammersley, 1997), psychological research in music (Hargreaves, 1986), or philosophical (Jorgensen, 2001) and methodological debates (Bresler, 1996). The relationship between theory and practice is an argument at the centre of issues within the psychological and educational research communities concerning legitimating as research certain non-scientific, arts-based forms of educational enquiry (Barone, 2001), authorising children's perspectives (Cook-Sather, 2002), and scepticism about the contributions of less preferred methods (Snow, 2001). The gap between the cognitive work that brings forward models, the educational research and the experimental approach that should validate them is huge (Shehan Campbell, 2002b).

7.9 Concluding thoughts

What these earlier findings contribute to our understanding of the nature of children's meaning-making as composers is that: (1) multiple representations of the phenomenal world of children composing are essential to the music research enterprise; and (2) our task, as researchers, in the narrowing of the gap between theory and practice, requires more theory building and theory testing if we are to find a satisfactory conceptual framework for empirical research in children's musical composition. While there are undoubtedly individualistic, universal as well as sociocultural, aspects of children's composition experience and meaning, the choice here is not simply between sound and misguided sets of assumptions; rather, it is a choice between different and complementary research agendas, many of which need to be addressed and, where possible, integrated (Burnard & Younker, 2004).

Children get great satisfaction out of talking about their own composing processes and compositions. Simply having children experience composing may not be enough. As researchers and teachers we need to help them to develop a language for talking about composing and about themselves as composers. They need to feel that it is legitimate for them to contribute actively to discussions about conceptualisations of composing, children's experiences of composing, and the transformations that occur in their

relationships with composing. In order for children to make sense of their own compositional engagement and see themselves as composers, we need to rethink how we view children composing. Only by taking into account the sociocultural situatedness and multivoicedness of children composing can we properly know and understand children's meaning-making as composers.

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8 Processes and teaching strategies in musical improvisation with children

Johannella Tafuri

8.1 Introduction

At some point in their career music teachers will, in most countries, have to face the sometimes daunting prospect of using composition or improvisation in the classroom.

Perhaps they already have some idea of how to deal with it, or perhaps not, but one of the most important elements of didactic competence is undoubtedly the knowledge of the theoretical background lying behind the strategies teachers intend to adopt. Improvisation and composition are strictly related to creativity and it is imperative that all music teachers, or, in a wider sense, music educators, be aware that through their activity they can promote or inhibit the creative potential of each student.

This chapter will first briefly look at the subject of creative behaviour from an educational point of view, both in general and applied to music. It will then move on to the field of musical improvisation and will look at several studies carried out with children, including the project in which the present author is involved. Finally, some suggestions will be offered that might help teachers approach the subject with a clearer frame of mind.

8.2 The development of creative potential

The first questions that music teachers might ask themselves are: Why do I have to teach children to compose? What is it for? Can it be learned or it is something intuitive that requires specific talents? Aren't composers found in the cradle?

Many music educators are in fact convinced that composition cannot be taught, that it is something to be left to highly skilled professionals. In reality they are not trained in it because musical curricula tend not to include it; and then they have to face the problem of how to evaluate the results, knowing in any case that the study of composition is not highly valued in Western music education (Hargreaves, 1999; Sawyer, 1999; Tafuri, 1998).

However, teachers with a greater sense of responsibility might start from the general assumption that one of the most important aims of education

is the development of the ability to express oneself and to communicate, especially in artistic fields. Following this conviction they might ask themselves if everyone possesses a potential ability to invent, to "create" something in whatever domain and, more deeply, what is meant by creativity, before applying it to music.

Let us consider for a moment the actual concept of creativity. The first thing that often comes to mind is its manifestation at a highly developed level in some famous people or, at least, a behaviour deviating from common practices. But I would like to start by considering creativity as a potential given to all from birth, whose realization and development depend on a huge number of factors. This assumption is in line with a person-centred point of view and with the idea of "everyday creativity" as a quality possessed by all (Hargreaves, 1986; Sawyer, 1999). Ward, Smith, and Finke (1999) see creative capacity as an essential property of normative human cognition. Sternberg and Lubart (1999, p. 11) believe that "creativity requires a confluence of six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation, and environment."

In his individual case studies, Gardner (1993) favours the monitoring of several different systems including the affective experiences the creator undergoes and the personality traits (independence, self-confidence, ambition, unconventionality, etc.). Taking account of the three possible kinds of manifestations dealt with in Gardner's study (1993, p. 35), the term *creative* could embrace any "solution to a problem", any "product fashioned", or any "question asked" that arises for the first time from an intentional act carried out by someone.

Here I would like to consider creativity in its original and more generic meaning, namely the act and process of making something new. Novelty is undoubtedly one of the most important properties of a creative product, together with originality, a fact acknowledged by all theorists of creativity. In a professional field, "novelty" needs to be recognized by a particular field of judges, as Csikszentmihalyi (1988) points out in his three-node model (individual talent; domain/discipline; field: judges, institutions). In a developmental field, however, novelty could simply mean that it is something produced for the first time by a particular child who is not copying, repeating, or imitating, but is inventing. In synthesis, I assume that, in a developmental field, a product is creative when it is novel for its author, not for the society to which the subject belongs, when the process of associating or combining or transforming these concrete materials (sounds, words, images, etc.), rules or concepts happens intentionally in this child for the first time. "Intentionally" means that it is not produced by chance, but it does not necessarily involve the awareness of what has been done.

It is clear that in order to produce something new it is necessary to be able to manage certain materials on the basis of some sort of rules or, in a broader sense, some organizational procedure ("rules" and "procedures" will be used in this context as synonymous), and we know that familiarization with

materials and assimilation of rules start from birth, or even earlier as far as sounds are concerned (Lecanuet, 1995).

In order to be more creative, a musical "novelty" in the sense stated above (not copied nor invented before) should be also "original", in that it should deviate from common practice. In other words, some significant aspect has to be different from what is commonly produced. This means that a person should know what is common practice in order to be able to deviate from it in a significant way. Originality can be considered as a dimension susceptible to gradation (more/less).

Sometimes originality can be refused or put down to inability. Saint-Saëns, for example, wrote that the music of Debussy was completely lacking in any musical ideas, style, logic, or common sense whatsoever (Lockspeiser, 1978).

Even though, in common language, the word *novel* is often used in the sense of original, I would prefer in the present context to consider novelty and originality as two different properties of creativity and then to use novel in a strict sense (i.e., where the author cannot be accused of plagiarism). Therefore, I consider the first creative act (something teachers should appreciate) to be the invention of something "novel" in a strict sense (not copied), and then the extent of its originality can be assessed. I will come back to these concepts later, when discussing the creative processes of children.

Applying to creativity the model suggested by Welch (1998) for the ontogenesis of musical behaviour, I propose a similar conceptual model taking "culture" and "creative ability" as the orthogonal dimensions in order to highlight the interaction between these two factors (Figure 8.1).

Moving from left to right along the horizontal axis (i.e., growing up) I indicate a progressive enculturation and acculturation that provide both familiarization with and assimilation of habits, rules, products, and interpretations of reality (physical, social, and personal), as well as the acquisition of different skills in different domains (for example, in managing a musical instrument).

Moving upwards along the vertical axis (the creativity line) I indicate the development of creativity considered as a continuum from the first

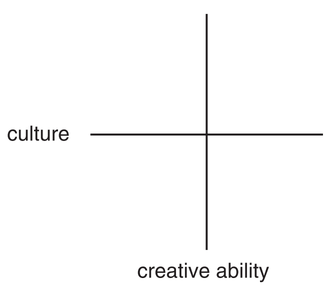

Figure 8.1 Interaction between culture and creative ability.

manifestations to the highest levels: in other words, the realization of each individual's own potential, a progressive ability to act in a novel, meaningful, and original way. This ability is manifested in different kinds of accomplished tasks in relation to what happens along the "culture" line.

This model does not intend to suggest that life is a linear path, a continuous ascending line towards the maximum development, but it should help in understanding the interactions between the two dimensions. Considering the intersections of these two orthogonal dimensions, an observable creative behaviour can be seen in each of the four quadrants. In the extreme bottom left-hand corner could be located the behaviour of a child after birth whose creative ability is at zero level, and in the opposite, top right, the behaviour of a very famous artist; for example, one of the seven "creative masters" studied by Gardner (1993): Picasso, Stravinsky, Einstein, Gandhi, etc., whose creative ability is at the maximum level. It is easy to imagine, and some studies have shown (Gardner, 1993; Hargreaves, 1986; Webster, 1990), just how many factors can influence the two routes (horizontal and vertical): the geographical, historical, and cultural environment, the personality, motivation, past experience, health, and so on. These can produce very different and irregular outcomes.

One person might be very expert because of age (with the consequent knowledge of reality) and acquired skills, but perhaps has not developed their creativity very much, having not been trained in creative activities, but rather having been pushed to look for "the" correct answer, etc. At the other extreme someone may have developed a creative manner, having been encouraged to look for different solutions, to deviate from common practices, but not having possessed adequate skills or knowledge in any particular domain to fulfil, at a professional level, their potential.

Children often display ways of combining elements or asking questions that might be deemed original, but their lack of skills and knowledge of existing rules and products means that their level of creativity cannot be considered high. The freedom from conformity and from adult assessment criteria that they have until a certain age allows them to bring about novel combinations, transformations, etc. But beneath this novelty there is a lack of skills and mental models. As they grow up they acquire skills, assimilate rules, and could improve their creativity, but it may happen that they start to look at their creative activity in a different way, looking for more conformity with adult models. As a consequence, they can lose their freedom, self-confidence and, perhaps even interest in their creative activity. This could be the reason why some authors found a "fourth-grade slump" in creative thinking (Hargreaves, 1986) or, more generally, a U-shaped development, even if others contradict this position, arguing for a continuous developmental process (Keegan, 1996).

I will come back to this model later, in the discussion (section 8.7).

8.3 Investigating musical improvisation

Musical creativity normally tends to be identified only with composition and improvisation, but over the past decade many attempts have been made to broaden this view to include such wide-ranging aspects as performing, listening, writing, and analysing. Composition and improvisation are similar and different at the same time. Both involve the production of new music but composition allows a revision – the chance to go back and forth during the compositional process – whereas improvisation is an extemporaneous process marked by irreversibility. This difference obviously influences processes and products and thus the ways to express one's own creativity.

Studies on composition and improvisation are generally considered as investigating musical creativity because the fundamental activity they look into is the "creation" of "new" music. Among the best overviews of research in this field is the work of Webster (1992), recently updated by the author (2002) and extended by Hickey (2002). Webster (2002) defines creativity in music as "the engagement of the mind in the active structured process of thinking in sound for the purpose of producing some product that is new for the creator". However, he preferred to use the term "creative thinking" (1987a), which better highlights how the mind works. Most of the literature presented by Webster deals with composition or improvisation, and the research of Swanwick and Tillman (1986) on "The sequence of musical development: A study of children's composition" is presented as "a theory of creative musical development" (Webster, 1992, p. 277). It is interesting to note that Tillman herself published an article (1989) on the same research entitled "Towards a model of development of children's musical creativity".

However, in reviewing the several studies on composition and improvisation, Hickey (2002) prefers to distinguish between those focusing on the technical characteristics or processes and those explicitly focusing on the creative aspects of compositional processes or products. In this perspective, she suggests that the music development model proposed by Swanwick and Tillman can be used to examine creative growth in music. Barrett (2003) regards as misleading the two assumptions that all composition experience is by definition "creative", and conversely, that "creative" experience in music education is "compositional" in nature. Composing and improvising are in any case a creative process in which varying levels of creativity can be found depending on the extent to which the music produced differs from extant music.

Improvisation is quite a young field of study from an educational point of view. A broad survey of pertinent research and a stimulating model have been given by one of the best theorists on improvisation: Jeff Pressing (1984, 1988). Apart from the research on materials and methods for teaching jazz improvisation, not many researchers have devoted their attention to improvisation in the classroom and in voice/instrumental teaching (Azzara, 2002).

Nevertheless, improvisation is "an example of creativity within the genre in 'real time', that is, there is no opportunity for revision", as Johnson-Laird

(1987, p. 84) states in looking for a computational model of creativity, which was presented some years later (Johnson-Laird, 2002). Improvisation is a particularly useful investigative tool since it provides direct and instant access to the creative process (Sloboda, 1985). Its educational value both socially and musically has been stressed (Della Pietra & Campbell, 1994; Kenny & Gellrich, 2002; McPherson, 1994; Webster, 1994) as has its collective and collaborative dimension (Baily, 1999; Hargreaves, 1999; Sawyer, 1999; Welch, 1999). The study of different manners and forms of improvisation in different cultures (Campbell & Teicher, 1997) highlights some aspects that can help students to be more musically inventive in their creative performances.

A closer look at the literature to obtain a synthetic overview shows that improvisation is most often associated with instrumental activity. However, I would also like to consider research on spontaneous singing since it provides interesting information about creative processes and the assimilation of musical structures.

Mention can be made of some pioneer studies on the relationship between spontaneous expression and the development of music in pre-school children. Moorhead and Pond (1941) dealt with melodic and rhythmic organization in spontaneous singing, while Sundin in the early 1960s (reported in Sundin, 1998), observed the spontaneous musical behaviour of children in a Stockholm kindergarten. His aim was to learn about their ability to sing familiar songs, to improvise their own songs, and to investigate the influence of the familiar context. An analysis of the songs invented by the children in comparison with other musical abilities led Sundin to define musical creativity as an expression of a general creative attitude influenced by the atmosphere of the school, social class, and gender (p. 50).

Concentrating on the uses and functions of children's spontaneous singing, Bjørkvold (1985) pointed out the relationship between the social context of improvised songs and their musical patterns. Other research, such as that of Dowling (1982), Davidson (1985, 1994), Lucchetti (1987) and Davies (1992, 1994), has dealt with spontaneous songs in children with the aim of studying the development of the ability to sing and to structure an invented song.

In terms of younger children, studies have been carried out on spontaneous singing at two to three years in a day-care setting (Young, 2003) and at home (Tafuri, 2003) with the aim of identifying the underlying processes that give rise to these vocal expressions and the presence of structures from our musical system.

In early life, the responses of infants to mothers in their first "musical" dialogues have been studied (Malloch, 1999; Tafuri & Villa, 2002; Tafuri, Villa, & Caterina, 2002). Newborns organize sounds in a way that for them is novel, and the fact that a certain intentionality is present in these early vocalizations means that they could actually be considered as embryonic improvisations.

With regard to instruments, a study similar to that of Sundin was carried

out by Mialaret (1997) with the aim of investigating structural, functional, and meaningful aspects in the improvisations of children aged between 2 years, 10 months and 9 years, 6 months.

A study focusing more on the expressive aspects of improvisation is that of Baroni (1978), which is based on the assumption that a fundamental process of creative thinking is the symbolic function, in the sense well explained by Piaget (1945) in his theory on thinking development. Working with children in the kindergarten, Baroni tried to demonstrate how the creative use of sound structures in composition and improvisation activities can help children to communicate the contents of their own fantasy world, to show their own way of seeing and listening to reality.

Moving onto studies carried out with older students, we find research focusing on more complex aspects. Burnard (1999) tried to discover how 12-year-old children participate and reflect on creating music in a personal way. The research explored certain aspects of instrument selection and bodily movement: the activities were presented not in terms of composition and improvisation, but in terms of making music in their own way, and children were told that making music could happen as a spontaneous single event (improvisation) or as a revised piece created over time (composition). Among the many aspects of creativity elucidated by this research, it is interesting to note that "composing involved a reflective synthesis of what *was known*, whereas improvising meant responding with what they *could do* in the moment" (p. 172, original emphasis).

Approaching the subject from a different angle, Kanellopoulos (1999) was interested in what students think, that is, in children's conception of musical improvisation. Ten eight-year-old children were invited to participate in a spontaneous music-making course where they were asked to improvise individually or with others; after the improvisation they were encouraged to discuss different aspects of their music making. Kanellopoulos interpreted the children's understanding of improvisation by suggesting three analytic concepts related more to the nature of music making than to the necessary skills: "a) Objectification; joint creation of the notion of improvised 'piece' . . . b) Thoughtfulness; the children's awareness of their immersed involvement into self-determined musical thinking. c) Shared intentionality; a sense of being heard, and a sense of listening" (Kanellopoulos, 1999, p. 175).

The study carried out by McMillan (1997) tries to verify whether improvisation encourages the development of a personal "voice" among students. After three years of investigation, five of the ten students selected had begun to develop a personal way to express themselves on their instruments. This study shows the usefulness of improvisation in the development of musicality.

Looking at improvisation from an educational perspective, in a study on high-school instrumentalists, McPherson (cited in McPherson, 1994) suggests that improvisation is very helpful in musical training and especially in the development of the ability to "think in sound". Interested in factors

improving instrumentalist training, he also proposed a tool for assessing improvisational skills.

8.4 Teaching improvisation: The IBIS project

In most developmental research on improvisation and composition, the aims are generally to study the processes, production, and behaviour of children; to analyse the properties of their products in terms of novelty, significance, and originality. Investigation of the relationship between the teacher's proposals and the processes activated, in order to reach some conclusion on teaching strategies and their consequences for the development of musical creativity, is not usually conducted. Kratus (1994) mentions this point when considering factors that still need more thorough investigation. Particularly concerned with the instructions given by teachers, he makes some suggestions on how to improve didactic activity (1994, 1995). Teaching strategies where particular attention is paid to task setting play an important role in didactic activity, even though teaching strategies obviously imply a much more complex process than the simple request for children to fulfil tasks.

References to the problem of setting specific tasks are relatively few and tend to deal with composition more than improvisation. Studying the teaching practices of a group of music teachers, Hogg (1994) analysed particularly the strategies chosen by them to facilitate students' composing and found relatively little attention to tasks. In her list of 16 strategies adopted by teachers, only three are related to tasks: to ensure that every task has the potential for a musical outcome; to keep the tasks simple; to set clear boundaries.

Research dealing more specifically with tasks, again in composition, is that of Burnard (1995) carried out with 11 15–16-year-old music students. Her aim was to verify how task designs influence the student's composition in relation to other factors. Four tasks were proposed: one "prescriptive task" involving specific musical demands; two "choice tasks" allowing students to select from a range of compositional options given; one "freedom task" providing independence in decision-making (apart from the constraint to compose for the voice). Burnard's findings suggest that students experienced constraints and freedom differently, according to their skills and their particular working style. Nevertheless, "task choice rather than freedom may provide appropriate challenges to a wider range of students" (p. 45).

An interest in the influence of teaching strategies on musical creativity development, and the fact that very little specific research has been dedicated to it, prompted me, in collaboration with my colleague Gabriella Baldi, to look more deeply into this area, limiting ourselves to the field of musical improvisation. This led to the setting up of a research project called IBIS (Insegnare ai Bambini a Improvvisare con gli Strumenti).

Our basic assumption is that the activation and maturation of the creative process depends on many factors, one of which is the strategies used by the teacher.

As stated above, we considered creativity as a potential given to all from birth, and that each child manifests their creativity when inventing a piece of music where sounds are combined according to some rules. Each new combination is a creative act.

My colleague and I therefore asked ourselves the following questions:

- How can teachers promote musical creative potential in children?
- Which tasks are more stimulating for the activation and development of creative potential?
- Which skills involving the use of rules in the invention of music can be developed spontaneously from the surrounding culture and environment?

In our attempt to answer these questions we first identified in many studies three types of tasks, or instructions, used by researchers when asking children to invent a piece of music:

(1) The instructions suggest a meaning that the invented music could express in some way: "a robot", "it is sunny and I am happy", "the king is arriving", a particular mood, etc. (Baroni, 1978; Freed Garrod, 1999; Swanwick & Tillman, 1986; Tafuri, 1998; Wiggins, 2002).
(2) The instructions refer to certain structural aspects such as to invent a piece with a beginning, a middle, and an end (Barrett, 1996; Freed Garrod, 1999; Webster, 1987b) or improvise in a particular form, or meter, or with contrasts, etc. (Wiggins, 2002).
(3) The instructions can simply be to invent a song or a piece, providing students with instruments (Davies, 1992; Kratus, 1991; Swanwick & Tillman, 1986).

After carrying out two pilot studies involving a small group of subjects in order to verify the usefulness of these instructions in the field of improvisation (Tafuri, 1998; Tafuri, Baldi, & Addessi, 1998), we chose the following tasks for our main research.

On the basis of the first of the three categories mentioned above, the children were asked: (1) to invent a piece that suggests "an old man and a child"; (2) to invent a piece that suggests "waking up". Since these two tasks involved the expression of meanings through music, they were labelled "semantic".

The second category is more concerned with rules, and so we decided to ask the children: (1) to invent a piece based on the rule of alternation; (2) to invent a piece based on the rule of repetition. These two tasks were labelled "rules".

The third category concerns the absence of instructions; we decided to give the children specific sounds and to ask them: (1) to invent a piece on five bars of a glockenspiel (from C to G); (2) to invent a piece featuring three different sounds on the tambourine (striking the skin, striking the wooden frame, and rubbing the skin). These tasks were labelled "materials".

The next step was to decide on the criteria to use in order to judge whether the improvisations could qualify as a manifestation of creativity or not. We first made reference to the model proposed by Delalande (1993), who suggested the presence of three phases in composition: (1) the exploration of the material object that produces sound; (2) the attention to the sound in its own right and the consequent search for different sounds; (3) the construction of a music in which some intentional elements of form can be identified. In this model, exploration and composition are considered as separate, the former being a phase preceding the latter, namely the intentional invention of music. Also, Kratus (1995) considers exploration as "a pre-improvisatory behaviour in which sounds are used in a loosely structured context" (p. 30).

We then decided to consider as a manifestation of creative thinking all the pieces invented by children (novel for them), if organized according to some sort of compositional procedure. As a consequence, the repetition of music already known, and the exploration of the instrument were not considered as a creative act.

The following hypotheses were then made:

(1) The semantic proposals favour the use of organizational procedures that are embedded in the semantic expression given to children (for example, "an old man and a child" can suggest contrast and alternation).
(2) The proposal of rules is the most prescriptive, and consequently produces the most organized improvisations.
(3) The offer of sound materials without specific instructions favours more exploration of the instrument.
(4) The ability to use organizational procedures, abandoning explorative behaviour, improves with age even in the absence of a formal music education.

8.5 Method

8.5.1 Participants

The study involved 132 children aged 7–10, attending primary school (35 from the 2nd year, 32 from the 3rd, 30 from the 4th and 35 from the 5th). The subjects were from medium–low socio-economic backgrounds and had no previous experience of musical composition or improvisation.

8.5.2 Materials

A soprano glockenspiel with a range C^3–F^4 with 2 beaters; a tambourine with beater.

8.5.3 Procedure

The children were taken individually to another classroom by one of the researchers. After a brief period of acquaintance, each child was asked to improvise six short pieces according to the six specific tasks outlined above (two "semantic", two "rules", two "materials"). The order of the tasks was varied into 12 different sequences. The order of the three tambourine sounds, when presented to the children, was also varied. Although the children were not required to explore the instruments before starting, the few children who asked were allowed to do so.

After each improvisation the children were interviewed about their composition ("What's your music like?", "What did you do?", etc.). All improvisations and dialogues were recorded.

8.6 Results

All 792 improvisations were transcribed. The glockenspiel pieces were transcribed using conventional notation with some additional signs when the meter was not clear. The improvisations on the tambourine were transcribed with the notation commonly used for this instrument in the Orff method, with some additional signs when necessary. Also, the dialogues were transcribed.

To analyse the children's improvisations, reference was made to various different compositional procedures, in particular those used by two researchers: Kratus (1991) listed 11 composing strategies such as repetition or variation, stepwise movement or skips, changes to the pitch or rhythm of the patterns; Barrett (1996) analysed the compositions of children aged 5 to 11 by identifying repetition and/or development through the use of alternation, sequence, inversion, diminution or augmentation, etc. For our analysis we chose: repetition of some elements, contrast brought about by changing some aspects (high/low register, slow/fast, etc.), alternation of the same elements, intensification of one or more features, diminution of durations or other features, presence of musical phrases, variation of some feature in the same pattern, symmetry between the phrases.

We also considered whether the set task had actually been accomplished and called this category "coherence". Finally we checked, by analysing the interviews, the awareness of the children of the rules used even if, as stated above, a creative act does not necessarily imply an awareness of the processes.

All the improvisations were first analysed individually by each researcher, and then the relative categorizations were compared. The few differences were resolved by discussing the structural details until agreement was reached.

The first phase in the analysis consisted of identifying four aspects:

(1) Which improvisations were structured according to an organizational procedure and which could be considered as exploration. Improvisations

were deemed as *explorational* if they involved only a series of notes played in an irregular and hesitant way, lacking any kind of organisation.
(2) The different compositional procedures used.
(3) The coherence between the task and result.
(4) The awareness of what had been done.

Table 8.1 gives, for children of different ages, the number of improvisations considered as exploration and the type of organizational procedures used in the others.

Table 8.1 also shows the coherence found between task and improvisations as well as the awareness demonstrated through the open answers, in which children provided interesting information about the processes behind their improvisation and how tasks influenced their creative thinking. The answers mostly contained descriptions of the organizational process, analyses of the musical traits, and interpretation of the sense given to music. In other words, they showed sensitivity to musical properties, sensitivity to interrelationships between musical ideas, and attention to what makes musical sense: three aspects that characterize musical intelligence (Gardner, 1985).

The consequences of the teacher's instructions on the improvising processes used were examined, so as to establish which were the most effective in promoting the ability to structure a piece of music and encouraging self-expression (Tafuri & Baldi, 1999).

The next phase was to go more deeply into the comprehension of the compositional procedures used by children, by analysing the same *corpus* of improvisations. We therefore analysed the processes involved in beginnings and endings (Tafuri, Baldi, & Caterina, 2003/2004), and in the central structure of children's improvisations (Baldi, Tafuri, & Caterina, 2003).

To help with the analysis of the beginnings and endings, reference was made to the theories previously set out by other authors (Baroni, Dalmonte, & Jacoboni, 2003; Stefani, 1976) regarding the presence of conventional procedures in a composition (different conventions according to different styles). All 792 improvisations (including those classified as explorational since they may contain some kind of beginning or ending) were then analysed on the basis of the classification system elaborated by Stefani (1976) for beginnings and by Alessandri (1985) and Ferrara (1985) for endings.

Looking in detail at the children's improvisations, it was surprising to see such a great variety of conventional procedures (Figures 8.2 and 8.3). They used all seven types of beginnings contained in our classification system (one or a few sounds followed by pause, arpeggios that serve as an introduction, presentation of a theme, etc.) and 12 of the 15 types of endings foreseen (acceleration, repetition, concentration, finishing on the tonic, softening and slowing down, etc.). The absence of any type of beginning (exploration) or ending (interruption) decreases with age, and the difference is statistically significant.

As far as the central structure of the improvisations is concerned, we again

Table 8.1 Improvisations (%) of children 7–10 years old

Improvisations of children	*Semantic*		*Rules*		*Materials*	
	Old/child	*Waking up*	*Alternat.*	*Repetition*	*Glocken.*	*Tambour.*
7 years old						
Exploration	65	81	50	49	75	66
Compositional procedures						
repetition	3	7	9	29	19	24
contrast	1	0	0	5	0	0
alternation	9	0	30	12	0	12
contr./altern.	20	0	0	0	0	0
intensification	0	0	0	0	0	0
inten./dimin.	0	0	0	0	0	0
phrases	0	0	0	0	2	0
variation	0	0	0	0	0	0
symmetry	0	0	0	0	0	0
Coherence with instructions	31	0	42	37	–	–
Awareness	22	3	18	17	0	0
8 years old						
Exploration	56	75	45	41	72	59
Compositional procedures						
repetition	3	19	13	41	22	34
contrast	9	0	3	3	0	0
alternation	0	9	52	25	0	16
contr./altern.	31	0	0	0	0	0
intensification	0	0	0	0	0	0
inten./dimin.	0	0	0	0	0	0
phrases	0	0	0	0	6	3
variation	0	0	0	0	0	0
symmetry	0	0	0	0	0	0
Coherence with instructions	41	0	52	41	–	–
Awareness	31	6	22	19	3	0
9 years old						
Exploration	23	63	37	23	53	33
Compositional procedures						
repetition	17	23	3	70	30	57
contrast	10	7	0	0	0	3
alternation	0	10	57	13	7	7
contr./altern.	40	0	0	0	0	0
intensification	0	0	0	0	0	0
inten./dimin.	0	0	0	0	0	0
phrases	10	7	3	7	17	13
variation	0	0	0	0	0	0
symmetry	0	0	0	0	0	0

Improvisations of children	*Semantic*		*Rules*		*Materials*	
	Old/ child	*Waking up*	*Alternat.*	*Repetition*	*Glocken.*	*Tambour.*
9 years old						
Coherence with instructions	50	0	57	70	–	–
Awareness	53	13	36	50	3	10
10 years old						
Exploration	22	49	22	11	57	27
Compositional procedures						
repetition	14	16	14	89	38	51
contrast	19	11	5	3	0	3
alternation	0	16	62	22	3	30
contr./altern.	49	0	0	0	0	0
intensification	0	11	0	0	0	3
inten./dimin.	0	0	0	0	0	3
phrases	3	5	0	0	16	16
variation	3	0	0	0	16	5
symmetry	0	0	0	0	3	3
Coherence with instructions	68	11	62	89	–	–
Awareness	68	16	54	73	19	19

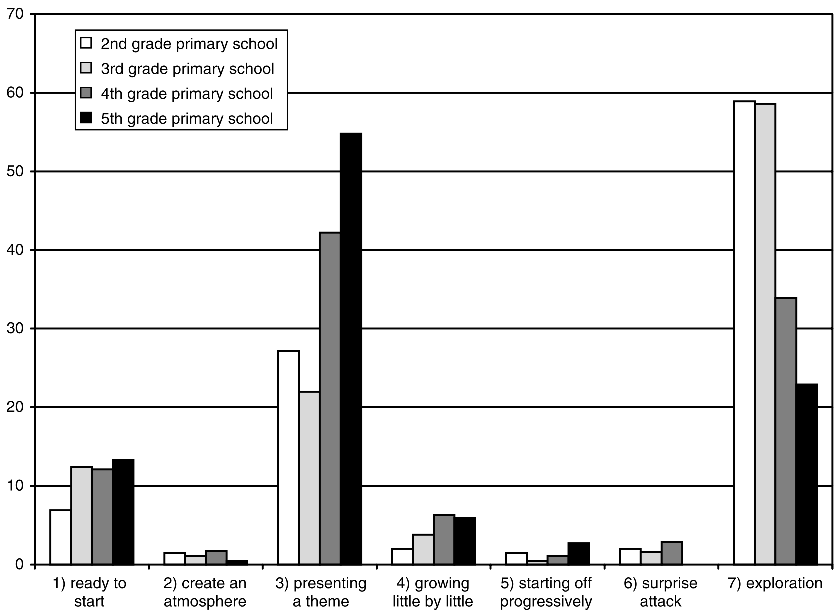

Figure 8.2 Categories of beginnings.

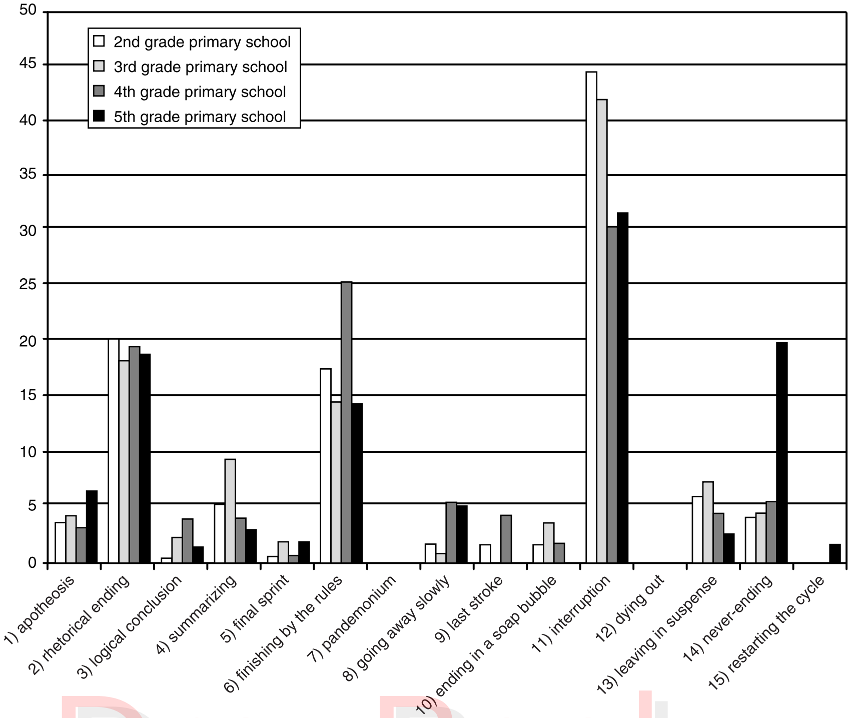

Figure 8.3 Categories of endings.

referred to the list of compositional procedures used in the first analysis (repetition, contrast, alternation, intensification, etc.) and identified six different groups of ways of composing characterized by more or less variety and/or complexity of organization (alternation of two notes in different registers; scales or arpeggios ascending and descending several times or organized with crescendo and diminuendo; short rhythmic or rhythmic–melodic patterns containing a tonal or modal centre; series of rhythmic–melodic motifs, or only rhythmic on the tambourine; series of phrases of the same length, with a tonal or modal centre, etc.). Figures 8.4 and 8.5 provide two musical examples.

The results of the analysis (Figure 8.6) provided evidence of the variety of organizational procedures used, and also revealed a marked increase with age (statistically significant) in using such procedures more frequently and with more complexity of organization.

8.7 Discussion

Looking at the results, several observations can be made. First, mention should be made of the discrepancy between the results produced by the two

Figure 8.4 Improvisation from the fourth group (9-year-old child).

Figure 8.5 Improvisation from the sixth group (10-year-old child).

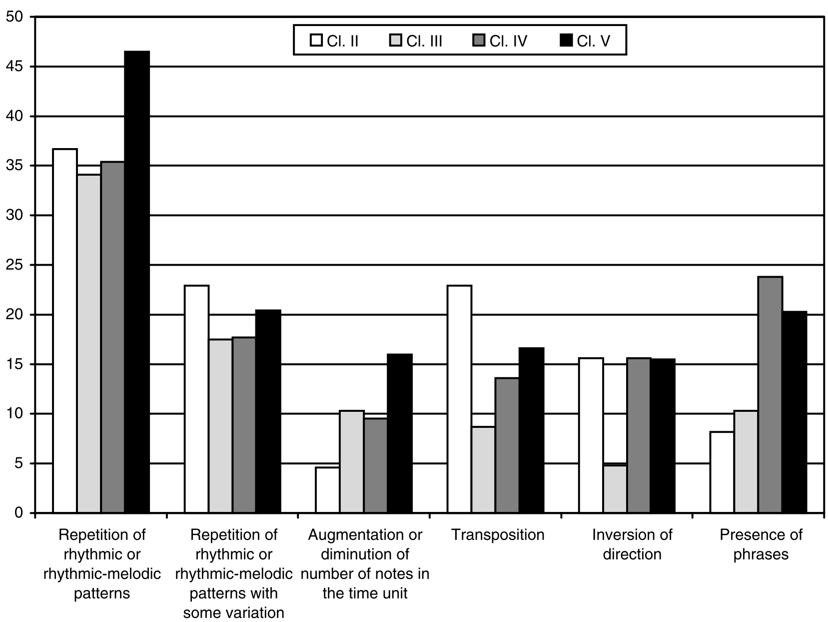

Figure 8.6 Percentages of improvisations according to the use of organizational procedures at different ages.

semantic proposals: the first gave rise to a high percentage of organized improvisations (*contrast* and *alternance*), whereas the second resulted in a high percentage of unstructured and explorative improvisations. It is evident that in the expression "waking up" it is more difficult for the children to catch the concept of "intensification", of a progressive transformation from a status of "less" to a status of "more" (movement, light, activities, etc.). In fact only a few children aged 10 years were able to use this procedure and to explain it.

The first hypothesis has therefore been confirmed, but with a condition: the semantic proposals favour the use of the organizational procedure embedded in the expression presented to children if it is easy to grasp in terms of utility for musical symbolization.

Differences can also be seen within the other pairs of tasks. The concept of repetition appears to have been easier to understand than alternance, and the organization of three sounds easier than that of five, perhaps because of the greater familiarity with the tambourine than with the glockenspiel, as well as the smaller number of sounds.

Looking at the second and third hypotheses, we can conclude that the improvisations with the task involving rules were better structured and more coherent with the task, though less varied, while those with the easiest semantic task ("an old man and a child") were a little less structured but more varied. Those lacking any specific instructions ("materials") and with the more difficult semantic task ("waking up") were even less structured and tended to favour a more exploratory behaviour.

In addition to the role of guide supplied by the tasks, the influence exerted by the instruments themselves should be mentioned. When analysing the structures, we must not overlook the suggestions offered by the particular instrument: its material, its shape and size, the gestures required to produce sound, all give ideas to go in some direction that might be impossible or less easy with another instrument. Other researchers (Kratus, 1995; Barrett, 1997) have in fact also stressed the point that before improvising or composing children need to explore the instruments in order to have sound ideas stored in memory.

Moving on to the improvement with age (fourth hypothesis), the marked decrease in exploration in favour of an increasing ability to organize a piece of music has an important meaning. It manifests the assimilation of rules and conventions from the repertoires of the cultural environment (given the development of general cognitive skills, as stated below) which are then used in the improvisation: an assimilation that can also be found in speech, in dance, etc. Different types of conventions were noted in the use of beginning or ending patterns and in the use of organizational procedures in the middle section: grammatical conventions (concluding with tonal cadence) or rhetorical (concluding with repetition and increasing intensity) as well as motor or narrative models (how to start or conclude) and vocal or instrumental (phrasing for breathing or a certain use of speed without the necessity to breathe).

This improvement, in children lacking any music education and from a medium–low socio-economic background, makes it possible to infer that these patterns can be learnt through exposure to and use of musical products, or temporal forms in a wider sense, when the cognitive mechanisms are ready. It underlines the important role of mechanisms such as memory, comparison, judgement, logic thinking, and reversible mind, and the role of an environment that is more or less culturally or musically stimulating, etc.

The interpretation of the results related to the specific procedures (repetition, alternation, phrasing, etc.) is more difficult: some decrease and others increase with age, but repetition and variation of patterns are the most common, irrespective of age. These are, in fact, the fundamental procedures used in famous large-scale compositions and, as already mentioned, two of the tasks specifically required the children to use them. Another improvement with age can be found in the use of phrases, which demonstrates an increasing ability of the children to structure a piece of music in a "discursive" way, that is, into segments that can be classified as phrases according to rhetorical conventions and vocal models.

What more explicit information on creative thinking can be drawn from these results?

As stated above, composition and improvisation are essentially creative processes and a creative act produces something novel and meaningful for its creator. The analysis of the improvisations in the present study shows that the majority of children, with a clear increase with age, produced "novel" pieces of music. It could therefore be concluded that all these children manifested their creative thinking and that their improvisations gave us instant access to their musical creative process.

Regarding the role of teaching strategies, it has been said that different tasks stimulated improvisations very different in their organization and variety: the "rules" tasks stimulated more structured but less varied improvisations in that the procedure was already established, while the "semantic" tasks stimulated the use of different procedures to a much higher degree, even if they were a bit less structured. It would therefore appear that the former type were less useful in promoting creative thinking, partly because of their lesser appeal to affective mechanisms.

For this reason teachers should be careful when choosing tasks because, as Wiggins states (2002, p. 85), "the nature of students' creative processes depends on the nature of the task", which should be designed to promote and support this process. In accordance with Finke, Ward, and Smith (1992) and Barrett (2003), the importance of tasks that give constraints is clear, in that they represent a necessary aspect of a creative process. It is thus possible to conclude that the extent of the activation of children's creative potential depends on the different nature of the tasks and the presence of constraints that are not too prescriptive.

The most difficult aspect to grasp in creative thinking is originality. As we have already said about this aspect of creative thinking, a first manifestation

can be found in the variety in the ways of using rules. "For any specific style there is a finite number of rules, but there is an indefinite number of possible strategies for realizing or instantiating such rules . . . The distinction between rules and strategies helps, I think, to clarify the concept of originality, as well as its correlative, creativity" (Meyer, 1989, pp. 20, 31). According to Meyer, then, a first type of originality can be found in the variety of ways of using rules (the "strategies"). But originality can also mean the deviation from given rules, or generally speaking from common practice, and this second aspect is more difficult to assess, especially in an educational setting. If it is not easy for judges (representing society) to assess to what extent a product diverges from existing rules, it is much more difficult to assess how much something made by a child is original in relation to his/her own world. The assessment literature on musical creativity (Hickey, 2002) does not solve the problem of how to establish the "common practice" (for adults? For children?) from which the improvisations of children could deviate.

Coming back to the developmental model presented in Figure 8.1, as they get older the children improve in their knowledge and skills, due to the cognitive development and the assimilation of environmental culture. They can therefore be placed at different points on the horizontal axis (from left to right) according to their age. As far as the creativity axis is concerned, one would have expected to place all the children at the beginning, at zero level, on account of their lack of practice in music education and particularly in music invention. However, the results show that the different age groups activated their music creative potential and expressed their musical ideas in a better way in direct proportion to their increasing age. This means that the increasing ability to organize an improvisation, using rules in a progressively more complex and varied way, showed different levels of creativity. They can thus be placed at different points on the vertical axis even though they were all "beginners" as far as improvisation was concerned.

8.8 Conclusions

The results obtained with the IBIS project provide important information on teaching strategies, as well as on the expertise possessed by children according to their age and their ability to act in a creative way.

The findings also pave the way for new research. Teaching strategies need more study, and other aspects, including the role of awareness (facilitated by teachers) in the activity of improvisation, merit further attention. Some investigation could also be conducted of what children consider common or new in music.

A longitudinal study would be able to show the ground covered so far, and where musical creativity would stop in the absence of explicitly acquired technical musical skills.

The findings of the present study seem to confirm that the more children are offered stimulating proposals and are encouraged to express their ideas

using assimilated rules, the more their musical creative thinking will be developed.

If teachers are convinced of the importance of creativity not only in music but in life, they should offer the appropriate conditions for the realization of the creative potential of each individual. In order to attain this goal, I suggest promoting:

- explorational activity of sound (voice, instruments, objects, electronic production);
- improvisational activity with specific tasks;
- analysis of process and results, made individually and collectively, in order to acquire more awareness;
- assessment of compliance with the instructions and of the internal coherence necessary for the meaningfulness of the action/product;
- work on different technical–formal properties, encouraging decisions that can lead to transformations and changes;
- knowledge of different decisions made by other authors (listening to repertoire);
- increasing awareness in subsequent improvisations.

Every new improvisation will appear "novel" to its author at the moment of creation. But this "novelty" can soon lose its significance if compared with what already exists. As knowledge of reality expands, the terms of comparison grow wider: it becomes increasingly possible for children to understand what is really new, and foster their own creative thinking towards original application of existing rules and the change of rules. According to Gardner (1993, p. 31):

> If, in early life, children have the opportunity to discover much about their world and to do so in a comfortable, exploring way, they will accumulate an invaluable "capital of creativity", on which they can draw in later life.

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Part IV

Creativity in musical performance

9 Creativity, originality, and value in music performance

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9.1 Introduction

In the nineteenth century, performers such as Nicolò Paganini and Franz Liszt came to embody creativity. As musicians of not only renowned physical skill but inimitable artistic insight, they were typically viewed as either divinely or diabolically inspired, offering normal mortals rare glimpses of another world (Johnson, 1995). Their feats of accomplishment – or at least the legends surrounding those feats – have set an imperative for originality that persists to this day, not only in the arts but across every facet of human endeavour. Within Western musical traditions (and indeed all traditions that recognise broad stratifications of musical competence), "eminence" in performance is defined with reference to those who go beyond the accomplishments of their peers and teachers to offer *novel* insight in their particular field (Ericsson, Krampe, & Tesch-Römer, 1993). Today's most distinguished performing musicians – be they in classical, jazz, rock, pop, folk, or other genres – are people who offer new musical possibilities to their audiences. Yet, although innovative performances are typically seen as treasured events, there seems to be a limit to audiences' acceptance of novelty before it is rejected as unmusical, inappropriate, or tasteless. Bound by cultural traditions and stylistic norms, innovative musicians must tread a fine line between the unique and the downright outrageous.

The term *creativity*, however, seems in constant danger of collapsing under the weight of its own plurality. It is common in everyday parlance, of course, and arts discourse in particular is filled with talk about its importance. To be a great artist, it is said, one must have unusual capacity for creativity, and so create products (in the broadest sense; e.g., compositions, performances, paintings, poems) of the highest quality and utmost originality. The same features of this anecdote that make it so widely appealing – its apparent generality and fervent idealism towards identifying excellence – also suggest why research into creativity is so complex. What, for instance, is the source of this creative capacity? To what other psychological characteristics and processes is it related (e.g., personality, motivation and intelligence, and/or tendencies toward schizophrenia and psychoticism)? Once a researcher has

acknowledged such questions (whether or not it is their intention to answer them), they must consider the critically important social psychological factors that impinge on the assessment and acceptance of creativity within a given society. Are certain "products" of creativity valued more than others? What exactly are the benchmarks for assessing the quality and functionality of these products? And, perhaps most importantly, how can society effectively identify and foster creativity within its educational systems?

It seems, therefore, that research into creativity offers mixed possibilities for scholars across the arts and sciences. On the one hand, it promises to provide insight into the heights of mental and physical prowess, as well as how these link to the depths of mental despair. On the other, it is apparent that creativity can only be defined within a tide of ever-changing social and cultural constraints, and so is resistant to precise definition and quantification both within and across cultures. In this chapter, we aim to distinguish between the concepts of *creativity, originality* and *value*, and argue that future research in this area must unpack the various roles of each in order to understand human excellence. We go on to consider the relationship between originality and value in the context of Western classical performance, and offer a tentative model of how they may co-vary.

9.2 The delineation of three parameters

Current discourse on creativity – from anecdotal accounts to systematic investigations – often conflates three quite distinct concepts: (1) "creativity" as a component of human cognition and psychological functioning; (2) "originality" as the probability that a thought, behaviour, or product has not occurred previously; and (3) "value" as determined by the society that witnesses the thought, behaviour or product. The relationship between these concepts has been an important topic in philosophical aesthetics since at least the work of Kant (particularly his *Critique of Judgement*, 1790/1978). Establishing a cognitive basis for creativity has recently been a focus of interest in psychology (see Gardner, 1993a). More recently yet, researchers in the field of artificial intelligence (AI) have offered new analyses of the phenomenon of creativity, with a view to developing artificial "creative systems" (see Boden, 1991, 1994; Wiggins, 2001, 2003). Little in the way of consensus has emerged between these approaches (or, indeed, others from the fields of education, business, history, sociology, political science and more), and it is striking, if unsurprising, to note the way in which the various definitions suit the purposes of those promoting them (Wehner, Csikszentmihalyi, & Magyari-Beck, 1991).

By way of example, let us start by considering definitions from three different sources. Within psychology, some have defined creativity as "the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints)" (Sternberg & Lubart, 1999, p. 3). As a catch-all definition, this seems generally in line with

common usage. Certainly, we may wish to read the word "work" in fairly broad terms, and furthermore, we may quibble that "unexpected" and "original" are not synonymous with "novel" in quite the manner implied. But these are simply matters of clarification. Two more serious clarifications are required of the concepts of novelty and appropriateness. Firstly, *to whom* is "creative" work novel – to the individual or to others in the same society? It is possible to think of perfectly plausible instances where an individual, faced with some task requirement, arrives at a solution that is totally novel to himself, yet essentially the same as that produced (unbeknown to him) by other people hundreds of times before. We would want to say, perhaps, that the individual in question has been creative, but *not* original; it is not clear how this would square with the above definition. Secondly, how is appropriateness to be defined? Great works of art, for instance, are for most people the paradigmatic example of highly creative endeavour, but in what sense are they "appropriate" to a task? A narrow definition whereby "appropriate" is read as something like "efficient in performing a given function" fits very well indeed with the task-based paradigms of experimental psychology; however, it hardly seems helpful in identifying artistic creativity, since society does not evaluate art in terms of its functionality (although for an alternative view, see Kaufman, 2002). Taking the term broadly, the appropriateness of a work or an idea is less about function and more about the value placed on it by society, but this again will not suffice as part of a definition of creativity. Surely, for instance, works of art can be the product of a high level of creativity without being judged to be of high value.

A step along the road to a more abstract and formal definition is offered in the AI literature by Boden (1991, p. 32), who delineates more strictly between types:

> The psychological sense concerns ideas (whether in science, needlework, music, painting, literature . . .) that are fundamentally novel with respect to *the individual mind* which had the idea. If Mary Smith has an idea which she could not have had before, her idea is P-creative – no matter how many people may have had the same idea already. The historical sense applies to ideas that are fundamentally novel with respect to *the whole of human history*. Mary Smith's surprising idea is H-creative only if no one has ever had that idea before her.

In Boden's viewpoint, a P-creative person is one who is capable of producing P-creative ideas on a sustained basis. H-creative ideas, by contrast, are judged as such by society based on factors external to the creative individual, including historical accident and social fashion. P- and H-creativity are seen as marking the ends of a continuum – ranging from ideas novel only to the individual, to those original to some subset of humanity greater than one, to those unique to all of humanity. It is typically the case that H-creative ideas themselves change standards of evaluating creativity and excellence,

and thus set benchmarks against which society compares new ideas (see also Nickerson, 1999).

Boden is sensitive to the need to separate creativity and originality, and as individual labels, P- and H-creativity seem uncontentious. Placing them at either end of a continuum, however, is a different matter, for it strongly implies that they mark the extreme ends of the same process. Is this the case? Presumably someone who has an H-creative idea is also likely to be highly P-creative, but it is not clear how this could be represented on a continuum of creativity with P and H at the extremes. The implication of labelling something H-creative seems to be that it is widely thought valuable and useful; indeed, in a later paper, Boden insists that " 'creativity' implies positive evaluation" (1998, p. 354). But what label should be ascribed to ideas that are totally novel both to the individual *and* the society at large, but generally agreed to be worthless (a category that, let us be frank, is well represented in any discipline one cares to name)? Wiggins (2003) develops Boden's ideas into a formal framework capable of accounting for this type of case in a number of ways, but admits that the practical question of modelling relative value is still in need of elaboration.

A rather different and more radical example comes from the aesthetics literature. Götz (1981) identifies creativity directly with *making*: "creativity is the process or activity of deliberately concretising insight" (p. 300). What we commonly think of as the "creative process" consists of multiple stages, of which only one – that which occurs between the idea and the finished product – can be properly characterised as "creative". According to this view, most psychological research claiming to study creativity has done nothing of the kind; it has dealt with the antecedent stages but not the central phenomenon. Notably also, in comparison to the two definitions considered above, creativity in this view is an activity that is defined entirely *without* recourse to the notions of originality or value. This analysis may be appealing on paper, but it is something of a semantic sleight of hand. Rather than attempting to unpick the relationships between creativity, originality, and value that are implied in normal discourse, it defines away the problem entirely.

This brief and (by necessity) extremely selective review of definitions illustrates something of the range of thinking that has accompanied creativity. The delineation of parameters that we present below, then, is not novel as such. To an extent this follows previous examples in drawing definitions appropriate to our purpose, which is to discuss the relationship between creativity, originality, and value in performances of music. Nevertheless, our definitions are intended to capture something of their everyday meanings.

9.2.1 Creativity

Scholars have had a difficult time attempting to characterise creativity. This is partly because it has been virtually impossible to offer an unambiguous and broadly agreed-upon definition, and partly because the phenomenon

itself has proven extremely hard to isolate empirically. Moreover, creativity, especially in the arts, has a deeply entrenched mythology, whereby it is construed as a mysterious, unknowable process. Such a perspective has done little to benefit the position of creativity as a research topic, many investigators simply opting to ignore it and focus on more immediately tractable problems. This is, needless to say, rather a disappointing state of affairs, given the obvious centrality of creative processes to human life in general, in all domains of endeavour.

It would be a mistake to think of creative processes as in some way special or mysterious, or even, in fact, as being particularly rare (see Guilford, 1950, for further discussion). Creativity of some kind is evident in even the most mundane situations. Is the commonplace task of, say, needing to find the most efficient arrangement for packing shopping bags into the boot of a car so very different in kind from the task facing an engineer searching for new ways to pack electronic components into a telephone handset? In both cases, there is a need to perform some task (to fit objects efficiently into a limited physical space), a medium in which the task must be performed (a fixed physical space), and a process of creating an appropriate strategy. And is, for instance, writing a note for a housemate asking them to turn on the washing machine so very different to writing a poem about the difficulties involved in sharing the same domestic space with another person? In both cases, there is a desire to express some idea ("please put on the washing"; "domestic sharing is trickier than it appears"), a medium through which to express it (the written word), and a creative process of working out the best way to do so. Probably what most people would say is that a greater *degree* (or amount, or level) of creativity was required to write the poem than the note, or to devise the handset than pack the car.

It seems that when we talk about the degree of creativity exhibited by a person in the production of some outcome, we are (loosely) referring to the extent to which it differs from what might have been expected on the basis of that person's previously existing knowledge and experience. So, perhaps the best way to conceptualise the degree of creativity involved in a given act is as a scale, ranging from a solution that is identical to one previously employed by that person (and thus totally predictable on that basis, requiring no creativity at all) to a solution that is utterly unlike anything that could be predicted. The essence of degree of creativity is that it is individual-specific and relates to the likelihood of arriving at *just that* solution given what might have been otherwise expected. Note, however, that in the everyday sense, "creative" is almost invariably used to refer just to relatively unlikely ideas or outcomes. So, usually when we describe a person's idea or act as being creative, we are in effect saying that it is "sufficiently creative as to be relatively unlikely given the experience and knowledge of the person."

Something similar to this approach is implied by Gardner (1993b) in his distinction between "little c" and "big C" creativity. The former is characterised as "the sort [of creativity] which all of us evince in our daily

lives", while the latter is "the kind of big breakthrough which occurs only very occasionally" (p. 29). However, Gardner's definitions point not just to the degree of creativity of some event or outcome (as discussed above) but also to the *frequency* with which a person is likely to have creative ideas. It seems likely that these dimensions will often be correlated, such that people who are creative more often are usually more creative, and those who are creative less often are usually less creative. However, it is also quite feasible for there to be no correlation – one person may have brilliant flashes of creativity only intermittently, while another may be constantly innovating in small, relatively insignificant ways with hardly any moments of tremendous inspiration.

If the creativity of an individual process or product can be defined only in terms of those doing the creating – that is, their knowledge, experience, and (to the extent that it may be a correlate) their general tendency to be creative – is it possible to say anything about creativity as a generic psychological process? Is creativity a discrete capability that operates across different domains of endeavour – in other words, are "creative" people creative in whatever they turn their hand to? It is difficult to give a firm answer to these questions, but this is not to say that conceptual and methodological progress has eluded researchers. For example, three influential theories in this area are Kris's (1952) theory of primary process cognition, Mendelsohn's (1976) theory of defocused attention, and Mednick's (1962) theory of associative hierarchies. The three theories are, in fact, very similar in content but are expressed through different vocabularies (Martindale, 1999). They state, respectively, that creativity hinges upon one's ability to:

(1) "regress" to a primary process state of consciousness (which is free associative, analogical, and concrete; as opposed to a secondary process, which is abstract, logical, and reality-oriented);
(2) widen one's focus of attention so that several connections and ideas are attended to at once;
(3) develop and exploit flat associative hierarchies of ideas (i.e., be able to associate a wider range of ideas to any one stimulus; e.g., when presented with the word "table", thinking of words such as "food" or "airplane", rather than the much more commonly elicited "chair").

Although a great deal of research has been published in support of these (and other) theories, a number of questions remain as to their ability to explain unique human achievement at the highest of levels. For example, several studies confirm Kris's theory that "creative" people have easier access to primary process modes of thought. Such people – as compared with "uncreative" people – report more fantasy activity (Lynn & Rhue, 1986), remember their dreams better (Hudson, 1975), are more easily hypnotised (Lynn & Rhue, 1986), are over-represented among the relatives of people with schizophrenia (Heston, 1966; Karlsson, 1968; McNeil, 1971), and typically score higher on tests of psychoticism (Eysenck, 1995). Yet what seems to be unique

about creativity is not just whether an individual thinks slightly outside a population's norm, but how they bring novel ideas to fruition, how the resulting products are viewed and valued by society at the time of production, and how well their body of work stands up to scrutiny over time.

9.2.2 Originality

If creativity is to be seen as an individual-specific process, just what do we mean when we describe something (an artwork, a composition, an idea) as "original"? Crudely, of course, we say that something is original if some significant aspect of it is *new*, in the sense of not having been produced before by anyone to the best of our knowledge. The product in question need not be a concrete object of any kind (as with creativity, we often talk about original concepts, thoughts, ideas), but anything that is the outcome of some creative process. The first criterion for originality, then, seems to be as follows: whatever type of thing is being referred to, for it to be original it must be qualitatively different in some respect from any previously known instance of that type.

Novelty, in the broad sense, is thus a necessary condition for originality, but it does not seem to be a sufficient condition. For a start, originality is clearly distinct from uniqueness. Strictly, for example, every performance of a piece of music is unique in that it takes place at a different time and place. Must we thus say that every performance is original? Similarly, every musical composition is unique in the strict sense that it does not contain exactly the same notes in the same order as any other composition. Again, should we describe every different piece of music ever written as original? This would seem to devalue the notion of originality to the point of redundancy and, in any case, is clearly not in step with how the word is commonly used in practice.

An alternative is to see originality not as a category but, like creativity, as a dimension. The philosopher John Hospers (1986) draws a distinction between instances of some type of thing that are "highly original" as opposed to being "slightly original", noting that it is possible for a work of art or music to be "original and yet a total bore" (p. 247). An unwarranted conflation of originality with value notwithstanding, this sounds like a more useful alternative terminology. However, since "highly original" is now just the upper bound of a hypothesised originality scale, this only serves to solve one problem by creating a new one: how do we distinguish the highly original from that which is only slightly original?

The ascription of originality seems to imply that the thing under consideration is not just *trivially* different from other similar examples, but different in some significant way. The idea of "significant" originality has been noted elsewhere, although in slightly different terms. Beardsley (1962), for instance, speaks of "notable" difference, such that an original object differs "from anything else that was known by its creator to exist at the time" (p. 460). Sibley (1985), by contrast, speaks of "relevant" difference, with the implication

that this is a difference as apprehended by a third party (i.e., *not* by the originator of the object, or at least not only), and the qualification that "which differences are relevant will vary case by case" (p. 170). For reasons that will become clearer below, we tend towards the latter view – something is "significantly original" if it is readily distinguished from others of its type *in the eyes of a third party*. Note that no evaluative judgement whatsoever is implied here. In other words, it need not be the case that something appreciated as significantly original is also appreciated as having value by virtue of that originality.

A consequence of this argument is that originality is necessarily a relative term; something can only be properly described as original *relative to* other similar instances of the type. This is actually a stricter condition than it might appear at first sight. Obviously, of course, a thing can only be original relative to other instances of the same type of thing: a piece of music, for instance, cannot be original by virtue of being significantly different from all previous designs of chair. More subtly, however, a thing can only be original relative to other instances of the same type of thing *within a given culture*. We would not say, for example, that a piece of Indian music is original by virtue of being different from music from the Western classical period, although it might well be original when considered against other works from the Indian classical repertoire. To describe something as original is thus to say that it is different from other instances of that type of thing within the cultural context in which it is situated.

Cultural contexts are themselves defined by the opinions and preferences of people within the culture. If the originality of some thing is dependent on its relative cultural position, then this is in effect to say that it is dependent on the combined opinions of people within the culture who are knowledgeable about the type of thing in question. The originality of a composition, for example, depends not on any objective or quantifiable measure of "difference" from the nearest previously extant piece of music, but rather on the extent to which a majority of people believe it to be more or less original than all similar pieces in the repertoire. This "subjective" definition of originality may run counter to intuition – after all, why not simply say that something is original if it differs from all other instances of that type of thing *tout court*? The problem is that originality could then only be ascribed on the assumption of perfect information. Imagine that composer *A* worked alone, completing hundreds of scores in an innovative style totally unlike any that had previously existed, but that he did not show them to anyone and they were not discovered until many years after his death. In the interim, composer *B* happened upon the same innovation, and her work was performed widely and to critical acclaim. Is it original? Objectively and non-trivially, it is not. But it is easy to see from this example that an objective definition prohibits the proper ascription of originality to anything, except in the hypothetical case where every previous relevant instance is known. Originality, then, is best conceptualised in subjective, or at least *inter*subjective, terms.

So, for any given instance of a type there is a range of variability within which a majority of suitably qualified people will identify it as being typical of that type. In other words, there emerges a "bare minimum" level of originality, below which an instance of a type is generally agreed to be identical or only trivially different to some previous instance. When in everyday language something is described as being "original", this really means something like: "sufficiently original as to lie beyond the bare minimum level of accepted originality". Note how this is rather similar to the everyday usage of "creative" as outlined above.

The set of things to which any given instance of a type should be compared in identifying its originality is not always clear-cut. Take, for instance, a piano sonata by Beethoven. To what other pieces of music should it be compared if its originality is to be assessed: all of Beethoven's previous piano sonatas, all his previous compositions, all the compositions of all his contemporaries, or all the music written in Europe over the previous 200 years? A case could be made for any of these, and more. Furthermore, it is hard to imagine that any domain-independent criteria could be devised that might help us decide. On the other hand, this is an empirical problem that could, presumably, be solved as necessary in the context of any particular domain.

What form does originality take? What is the nature of the differences that pertain between instances of some type that are highly original and instances that are only trivially original? A precise answer to this question would be completely domain-specific. Broadly, however, it seems that originality can manifest itself in two main ways: *formal* and *conceptual* (Kraft, 1986 refers to "form" and "content"). Formal originality refers to the actual means by which the concept is realised, whereas conceptual originality refers to the idea itself. To clarify this distinction, imagine that two designers both produce chairs. One is constructed with materials borrowed from the space industry, manufactured by processes at the cutting edge of engineering, and has a striking contemporary design such that it is, physically, unlike any previously existing chair. Functionally, though, it is exactly the same as any other chair: a piece of furniture intended for sitting comfortably. The second chair uses traditional materials and construction techniques and looks just the same as any other chair (perhaps, for the sake of argument, it looks *exactly* the same as some previously existing chair). However, the designer has built the chair with the express intention of displaying it in a gallery as a piece of art, under the title "A completely typical chair". In the first example, we could say that the chair is original by virtue of its formal characteristics, which render it completely unlike any previous instance of the type "chair". In the second example, we could say that the chair is original by virtue of conception, which also, in a different way, renders it completely unlike any previous instance of the type "chair" (note that this should not be confused with "conceptual" art, of the type popularised in the UK in the 1990s).

Formal and conceptual originality are not mutually exclusive categories, and in the majority of instances they will overlap to some degree, since the

instantiation of new concepts very often requires formal innovation. Indeed, in some domains of endeavour (e.g., industrial design), form and concept are more or less synonymous, and in the arts, the distinction can be particularly blurred. Some philosophers have criticised formal stasis in a series of art works by the same artist as "self-plagiarism", the implication being that originality lies in formal innovation alone (see Goldblatt's 1984 critique of Rothko). If this seems an unduly limited approach, it is probably symptomatic of the fact that formal innovation in the arts is generally easier to recognise than conceptual innovation. In music, identifying the highly original can be difficult precisely because the interpretation of music is itself so notoriously subjective. For instance, little in purely stylistic terms separates Mozart from a multitude of other contemporaneous composers (e.g., Hummel, Haffner, and Salieri). They wrote for the same forces, using the same well-understood conventions of harmony and structure. Mozart's originality, we would probably say, is in the *content* of his music – depth, beauty, poise, expressive power, and so on. However, the converse (a piece that is original largely by virtue of its formal features but with unoriginal content) is more rare; the third section of Berio's *Sinfonia*, which is a transcription of the *Scherzo* from Mahler's Second Symphony, is perhaps a good example of this.

9.2.3 Value

The third strand to be teased apart in understanding creativity is "value". As with originality and creativity, value is here understood broadly; we take it as referring to the importance, significance or adjudged quality of some idea or product. Value, defined with this wide remit, is the major factor in determining the extent to which ideas and products are taken into the "canon".

An ongoing debate in philosophy concerns the metaphysical status of value and consequently of value judgements (Davies, 2003). In brief, the issue is this: is value absolute, in the sense that one thing (e.g., a painting) can be unequivocally said to be of more value than another, or is it necessarily subjective? This debate has been played out most extensively in the field of aesthetics, although there is no broadly agreed solution. On the one hand, it seems intuitively correct that value judgements should be regarded as wholly subjective. It soon becomes obvious, on the other hand, that taking this position leads to a relativistic conception of value in which it becomes impossible to say for certain that one thing is better than another. Many writers have found this latter implication so unpalatable that they have searched for plausible ways to preserve elements of both positions – that is, to safeguard the legitimacy of subjective opinion while also justifying normative value statements (see Kaufman, 2002).

While acknowledging the debate, we will not involve ourselves in it directly here. For present purposes, the following functional definition will suffice: the overall "value" of a product or idea is the mean value ascribed to it

by individuals within a given culture. Once again, the cultural context is important; it seems sensible, for instance, that the value of a piece of Indian music should be determined by the value judgements of those who typically listen to that music, and so on. Even within a given culture, however, the range of factors that can lead to something being valued are virtually limitless, and there is certainly not space here to enumerate them. It should be noted, though, that the actual characteristics of the thing in question are often not the sole basis on which value judgements are made. It seems that historical accident and individual/cultural biases, for instance, can play just as large or an even larger role. Mahler's symphonies were, for essentially social reasons, virtually unknown in Britain and much of Europe until the 1950s and 1960s, a situation that apparently bears little correspondence to the value that has subsequently been ascribed to them. Similarly, for most of the history of Western art music, works written by women have suffered from the *a priori* assumption that they will not be of equal quality or value to those by men. As Boden (1998) acknowledges, the near impossibility of defining and objectifying criteria makes evaluative processes extremely difficult to model.

What is the relationship between originality and value? Certainly originality may be one among the many factors influencing value judgements in some cases, but it is obviously not a sufficient condition for a product or idea to be valued by a society at large. It is not at all clear, moreover, whether it is even a necessary condition. Many works of art are valued precisely because they *exemplify* previously existing content or formal features, rather than because of the extent to which they depart from them (Bach's *Art of Fugue* being an especially good example of this). Likewise, it is commonly the case that highly original developments are not widely valued at all, or at least not until a substantial period of assimilation has occurred. In general, then, it seems there is no guarantee of a strong correlation between originality and value. However, since notions of value and originality are frequently conflated, this can sound curious; precisely because the perceived originality of a work is often cited as one of the *reasons* for its value, it is often assumed that one entails the other. Sibley (1985) emphasises that to describe something as original in everyday parlance may or may not have an evaluative implication, depending on context.

9.3 Creativity, originality and value in Western classical performance: A review and a model

For today's performers within the Western classical tradition, an imperative for originality persists among the public, educators, policy makers, and artists themselves – the assumption being that great performances are achievable only through unique artistic insight. However, when examining such performance through the lens of the common view of creativity (one that does not distinguish between creativity, originality, and value), it becomes difficult to imagine what the precise source of this insight might be and to predict in

what form(s) it will best be received. Certainly, Franz Liszt is commonly cited as one of the foremost musical innovators of all time, but where exactly does his innovation lie – in his ability to conjure up and captivate audiences with uniquely moving renditions of familiar tunes, in his efforts to compose new pieces that (at the time) extended the limits of the piano technique and offered musically significant contributions to the repertoire, or perhaps in his incomparable showmanship and ability to leave audiences in states of rapture or frenzy (depending on his desired effect)? Clearly, we could argue that creativity was present in all of these various pursuits, but where does that leave us in terms of understanding fundamental principles of creativity itself? In many respects, confused.

In contrast, by distinguishing between the concepts of creativity, originality, and value, researchers can begin to gain a greater appreciation of: (1) the (conscious and non-conscious) exploitation of psychological mechanisms that enable unique thought and behaviour; (2) the ways in which individuals reconcile such thoughts and behaviours with their knowledge of what has happened before; and (3) how the public will typically respond to certain types of innovation. As a great deal of theoretical and empirical work in psychology since the 1950s has purported to focus on the first of these, we draw upon examples in music performance in order to offer an initial theoretical analysis of the more culturally and socially driven concepts of originality and value. Music performance – and particularly that within the Western classical tradition – is a particularly apt domain for such an analysis and subsequent research to take place. There are closely confined stylistic boundaries for what is usually acceptable as a performance; although conventions change over time, they tend to be widely shared by the concert-going public. Creativity in performance, therefore, must occur in relation to these boundaries if the performance is to be deemed appropriately original and/or valuable at all. As a result, researchers do not need to impose false or ecologically invalid contextual constraints in their investigations.

In terms of originality, of all the outcomes within a given creative tradition, the largest number should be distributed normally around a hypothetical mean of perceived originality (as described above in Section 9.2.2). Figure 9.1 depicts this relationship graphically. The accuracy of this graph hinges on two criteria. First, the domains of endeavour to which the distribution applies are only those for which a degree of originality has come to be expected; solo music performance is an example *par excellence*. A distinctive, individualised approach to performance, for instance, may not be advisable for a section violinist within a symphony orchestra; individuality would need to be sacrificed for common ensemble goals and/or the musical vision of the conductor. However, if that violinist were to pursue a parallel career as a soloist, performances given within this context would be expected to differ somewhat from those of other violinists. Second, the performances to be included in Figure 9.1 can only be those that meet, at the very least, basic acceptability within the socio-cultural, stylistic, and/or professional

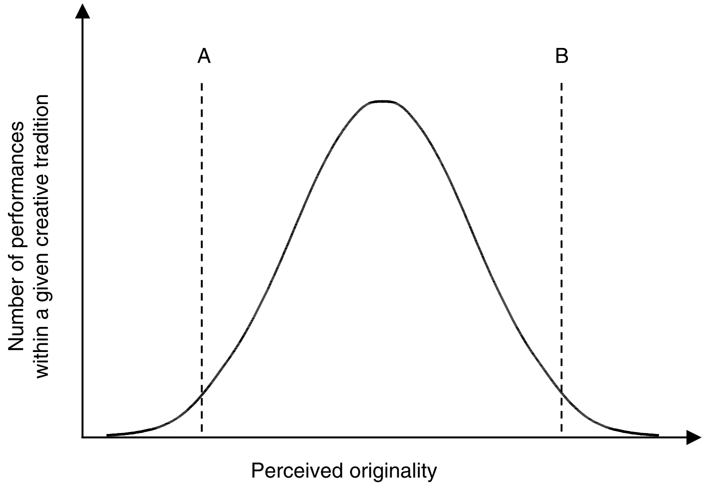

Figure 9.1 A hypothetical normal distribution of perceived originality (see text for explanation).

constraints of the particular creative tradition. When the violinist above gives a solo performance of Bach's Sonata in G minor, they *must* have the basic technical proficiency required to play the piece. Without this, the performance will not be deemed professionally acceptable by informed audiences (or even *un*informed audiences), and it could not, therefore, come to be represented in this distribution (in the same way that a distribution of the height of adult men in Europe should not, by definition, include the heights of male infants and toddlers, as they do not qualify as "adults").

Although Figure 9.1 proposes a normal distribution around a hypothetical mean of perceived originality, it does not suggest that outcomes in close proximity to the mean will necessarily be similar in substance. For example, two performances of a Chopin prelude may possess dramatically different qualities – in terms of phrasing, articulation, dynamics, tempo, and (if different editions are being used) actual notes played. Both may be perceived as being of high quality, while also judged by audiences as being neither completely derivative nor radically unlike all versions that preceded them. Extremely derivative and radical performances would fall, respectively, to the left of line A and to the right of line B, the implication being that they will occur less frequently within the distribution. In cases to the left of line A, the public will support only so many derivative performances in a given tradition; in cases to the right of line B, all Western classical performances will be so tightly embedded within the aforementioned boundaries that it would indeed be rare for individuals to break established rules so completely.

Having proposed this normal distribution of originality in performance, it is instructive to consider further the relationship between perceived originality

and perceived value. In other words, how does the mean value ascribed to performances of, say, Bach keyboard works, differ between those that are perceived to be more, or less, original than the norm? To give a feel for the kind of shape this relationship may take, let us consider some examples of well-known performers and performances. We should begin by noting that perceived originality is partially a function of the period and cultural environment of consumption, as well as to current conventions of performance practice (see Butt, 2002). Accepted interpretive conventions at the time of writing differ substantially from that, for example, of the interwar period (e.g., the use of rubato in Baroque repertoire). What was perceived as uncontroversial or derivative in one period may be highly controversial or original in another. Of course, certain controversial performances may continue to excite a wide range of responses through different periods; conversely, uncontroversial performances of one era may well become controversial at a later time.

Thus, at any given point in time, performances of the highest mean value across a given population of relevant listeners are likely to be those by eminent performers of repertoire in which they are widely acknowledged to be authoritative exponents. These performances achieve a degree of originality – certainly more than the "bare minimum" – but fall within the constraints of accepted stylistic conventions and show keen awareness of performing traditions within the chosen repertoire. Such stylistically informed performances are largely uncontroversial, in the sense that they do not typically provoke argument or challenge conventions. Their high mean value thus comes with relatively little variance. Murray Perahia's performances of Mozart's piano concertos (in which he directs the orchestra and plays the solo part) are a useful example of this type of performance. Perahia's performances are widely held to be both refined and communicative. He is known to consult a wide range of source material and mediates his experience of recent mainstream performing tradition with knowledge of eighteenth-century performing conventions. He employs analytical techniques in order to develop interpretive strategies. The violinist Hilary Hahn has become similarly recognised as an authoritative interpreter of Beethoven's Violin Concerto. Hahn chooses to play Kreisler's cadenza and adopts an interpretive style partly derived from traditions originating with Kreisler himself. The performances of Perahia and Hahn are both highly valued by audiences and critics alike.

There are, however, many interpretive approaches that defy convention, and these will inevitably excite more controversy. They are likely to be idiosyncratic and to challenge accepted tenets of performance practice. Glenn Gould's approach to performing Bach on the piano was, and still is, regarded as distinctive and highly original, particularly in terms of the articulation and projection of motivic material. Gould's Bach is certainly not unpopular, but over the relevant population of informed listeners, opinions differ widely about its merits. It is not hard to find people who value Gould's interpretations above all others; at the same time some react very negatively to them

and to a degree that is unlikely to be engendered by, for instance, András Schiff's urbane and measured performances of the same works. The *mean* value of Gould's Bach is probably somewhere below the level of Schiff's – after several decades, it is still considered to lie outside the mainstream – but the *variance* of opinion thereon is much greater. If Gould is the obvious exemplar, there are certainly others. A recent instance of marked originality in interpreting mainstream repertoire is Gidon Kremer's recording of the Beethoven Violin Concerto with the Chamber Orchestra of Europe under Nikolaus Harnoncourt. This is a challenging account of the work, as Kremer communicates far more urgency than contemporary listeners are used to hearing (e.g., in such performances as that of Hahn mentioned above). Other contemporary performers whose originality of interpretation stimulates such controversy include the pianist Arkady Volodos and the cellist Mischa Maisky. Past performers who may be argued to belong in this category have included the pianist Vladimir Horowitz and the violinist Bronislav Huberman. In all these cases, it seems that the variability of opinion is wide but that the mean value is somewhat below that of the most popular performances.

Moving towards interpretations that have even higher originality but verge on the eccentric, it seems that the mean value declines further while the divergence of opinion begins to decrease. Returning to Glenn Gould, his performance of Brahms's Piano Concerto No. 1 in 1962 with the New York Philharmonic Orchestra under Leonard Bernstein provides a particularly striking example. He performed the first movement at such a slow tempo and distorted Brahms's dynamic indications to such an extent that Bernstein publicly dissociated himself from the interpretation prior to its commencement (Bazzana, 1997). This interpretation, while undoubtedly highly original, was not a critical success and has not subsequently been adopted by other performers. On the relatively few occasions that Gould performed works from the Romantic period, he routinely adopted a far dryer articulation than is traditionally expected, partly by means of touch and partly by the restriction of his use of the sustaining pedal. Gould's performances of this repertoire meet with far less approval among listeners than his Bach recordings; they are widely agreed to be of relatively low value.

What of performances that are viewed as having originality below the "norm" level, but still above the "bare minimum"? At the extreme, consider a computer-generated performance based on some set of basic generative rules (Clarke, 1988; Todd, 1985). Such a performance may be viewed, on average, as just acceptable as a performance in its own right, but with little to distinguish it from others – in other words, on or just above the bare minimum level of originality. It seems likely that such a performance would have a relatively low mean value and that this would be widely agreed upon. A competent student performance that supplements the characteristics of the computer performance through stylistic awareness and by incorporating further expressive devices, but nevertheless fails to reveal significant originality, would likely have some intermediate mean value (probably more

worthwhile than the computer, but not in the same league as an eminent professional).

Figure 9.2 is an attempt to represent graphically the relationships we have described. The *x*-axis reflects *mean perceived originality* of some performance across a relevant population of listeners, with the zero point corresponding to the "bare minimum" originality. Thus, a performance of Bach's keyboard music would be ascribed some level of originality compared with other performances of Bach's keyboard music by informed listeners, and not compared with performances of, for example, jazz standards, popular songs, or even piano pieces by Brahms. The *y*-axis reflects *mean perceived value*; here, zero is the minimum point below which a performance is considered to have no aesthetic merit whatsoever. With all other things being equal (i.e., factors such as popularity, fame, and reputation of the performer set aside), we propose that the "originality value" curve will be positively skewed, as the most highly valued performances will typically fall within well-established traditions and, as a matter of course, be original only within constrained boundaries. The amount of perceived originality corresponding to the peak level of mean value is, therefore, relatively low (cf. Martindale and Moore's 1988 research on prototypicality effects, which suggests that favourable

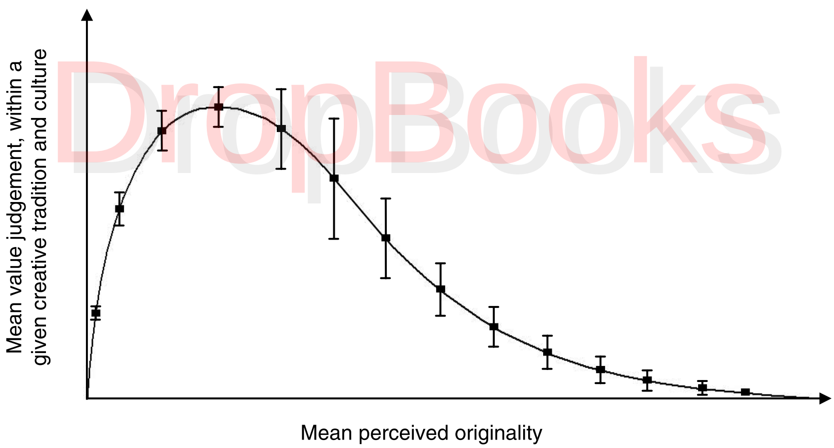

Figure 9.2 The originality–value curve, depicting the relationship between mean perceived originality of a performance and mean perceived value of that performance, across a relevant population of listeners. The curve represents a hypothetical "all other things being equal" scenario, where factors such as popularity, fame, and reputation are not considered. The zero point on the *x*-axis corresponds to the "bare minimum" level of originality, below which a performance is generally agreed to be identical or only trivially different to some previous instance. The zero point on the *y*-axis is the minimum point below which a performance is considered to have no aesthetic merit. The error bars on each point reflect the variance around the mean value judgements.

responses are positively related to stimuli that typify their representative category; see also Repp, 1997, for a compelling example of this musical domain).

As described above, variance around the hypothetical mean value judgements is likely to differ in relation to originality, and we have depicted this with error bars on each point in Figure 9.2. Variances to the left of the peak, where the hypothetical computerised and student performances lie, are likely to be uncontentiously small. Moving up to and over the peak, the variance may increase slightly, but only slightly; this is where we would expect to plot uncontroversial and widely popular performances, such as Perahia's Mozart, Hahn's Beethoven or Schiff's Bach. Moving down the curve, the variance increases dramatically for a period. In this region, we might place Gould's idiosyncratic Bach, controversial but still very popular with some. As the curve continues to move downwards asymptotically towards zero, the variance decreases as performances become both more original and less acceptable. The variance here is similar to that of the derivative performances to the far left of the curve, although the reasons *why* these performances are valued less may, of course, be rather different.

We noted above that perceived originality is partially a function of period and culture. Consequently, the curve should itself be viewed as reflecting a relationship that is subject to change. The kurtosis (or "peakedness") of the curve may change depending on the value that a society places on originality *per se*. For a society in which originality is a highly prized feature of a performance, the curve would take on a flatter shape, as a greater number of performances could feasibly fall near the peak. For one in which the originality of a performance is generally less important, the curve would take on a more peaked shape.

It is also important to note that the relative position of certain performances on the curve is itself subject to change. Were it the case that Gould's interpretation of the Brahms concerto had been embraced by other performers and gradually adopted as the mainstream approach, then from this later position it would no longer be perceived as highly original (although it would, of course, be possible to say "this performance must have seemed highly original *then*, but it does not seem so *now*"). A real example of a similar, if less pronounced, change is the way that the historical performance practice movement has redefined the "norms" for the performance of so-called "early" music (and, increasingly, nineteenth-century music) over a number of years.

In general, then, we accept that there can be no absolute, everlasting placement of specific products on the originality–value curve. We do propose, however, that the value judgements made by groups of informed individuals will tend to follow the basic shape and principles of the curve. One implication of the curve as it stands is that the amount of originality corresponding to the highest mean value is relatively small. This is deliberate; while there is much talk about the need for "originality" and "creativity" by the public, educators, policy makers, critics, and perhaps most of all by

artists themselves, it is not clear that originality, as such, is valued much at all in Western classical performance. The popular call for "originality" is, arguably, a conflation of concepts of precisely the kind we have attempted to criticise.

9.4 Conclusions

In this chapter, we have argued for the need to draw a more careful distinction between the concepts of creativity, originality and value. Through clarification of the conceptual framework in the way we have suggested, it becomes apparent that a great deal of work is still needed to explain the connection that exists between individual creativity and the wider social context in which it is situated. In particular, research should begin to explore the relationship between degree and frequency of creativity in the individual, and the extent to which these correlate with the perceived originality and value of their creations. This seems a more fruitful endeavour than treating the three aspects in complete isolation or, as is more common, simply assuming the existence of positive correlations between them.

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10 Exploring jazz and classical solo singing performance behaviours

A preliminary step towards understanding performer creativity

Jane Davidson and Alice Coulam

10.1 Creativity in musical performance

One of the immediate problems facing researchers is to agree on a satisfactory definition of the term "creativity". Swanwick and Tillman (1986) refer to it as being "an activity of original invention", and there are many genres of performance where the musical material is indeed created during the performance, e.g., free jazz. But, as Swanwick and Tillman suggest, music creation includes a spectrum of activities ranging from improvisation during a performance through to formalised and notated composition made by one individual that is presented to an audience by another individual. The emphasis of this composition–performance spectrum depends on the cultural context, with Western art music performance being a presentation of a pre-composed work, whereas many folk and jazz styles typically involve extemporising around a familiar work, or creating a new work in the moment of performance. Other musical cultures have different systems. So, in writing a chapter about creativity in performance, it is certainly important to identify the style and system of music being investigated, and to specify the precise nature of creativity to be examined.

The word "creativity" derives from the Latin word *creare*, implying being able to "bring something into existence deliberately". Thus, how a performer "owns" music by articulating and interpreting it during performance clearly indicates a creative process. Partially in an effort to avoid overly complicated theoretical arguments, researchers including Ericsson (1998, 1999) have discussed music performance, especially that of the Western art pre-composed tradition, as a form of expertise, highlighting the mental and physical skills involved in articulating and expressing the music from the mind, through the body, onto and out of the instrument. But, as Cook (1998) points out, the performer's use of music production skills to interpret the musical syntax happens within the framework of personal invention, and so the creative element of the task should not be denied. The degree of invention varies from

person to person, so defining what makes one performance more or less creative is a fascinating, though difficult, area for investigation.

We shall work with the definition of performance as a creative activity, drawing on the education research of Webster (1990), which proposes that musical creativity is dependent on:

- *Musical aptitudes:* these include knowledge of tonal and rhythmic imagery, musical syntax, and an ability to apply this knowledge flexibly according to context.
- *Conceptual understanding:* these are single cognitive facts that constitute the substance of music understanding.
- *Craftsmanship:* the ability to apply factual knowledge in the service of the musical task.
- *Aesthetic sensitivity:* the shaping of sound structures to capture the deepest levels of feelingful response – achieved over the full length of a musical work.

So, for creative musical performance, a skilled, crafted, and sensitive interpretation is necessary, operating within a specific cultural/stylistic framework (the "context" that Webster mentions), which results in a unique personally inventive act. We shall begin by exploring skills and interpretative matters within their cultural frameworks, and then propose which elements might contribute significantly to personal invention.

Anecdotal observation and biography can help to establish the role of performance behaviours as creative components of the performance. For example, by observing Keith Jarrett, Elsdon (forthcoming) notes that the jazz pianist creates musically by applying fixed fingering patterns in his playing, irrespective of harmonic concerns, and thus "new" performance effects are produced. Billie Holiday, sometimes criticised for her "reedy" vocal timbre, has been regarded as a "creative genius" as a result, it seems, of juxtaposing delicate inflexions of vocal timbre with pitch height (tuning of notes) and musical timing (dragging behind or pressing forward the beat), while simultaneously giving a very dramatic visual presentation of herself on stage (see Vail, 1996). A tension between the delicate vocal effects and simultaneous strong bodily engagement may account for emotional effects audiences report and appreciate as being original and creative. The opera singer Maria Callas, criticised for a lack of technical control in the upper register of her voice, was consistently complimented for her inventiveness, achieved through the way she combined emotional openness ("we can see and hear her crying with emotional intensity as she sings") with a bold presentation on the stage (see Edwards, 2001; Stancioff, 1987). In summary, we have some tentative indications of what might contribute to creativity in performance behaviour, and to performer appeal. As discussed above, the work in this domain has been largely anecdotal, based on observations made in biographies rather than systematic academic investigation, and so the current chapter becomes all the

more relevant. We choose to focus on the behavioural concerns rather than the musical, as Chaffin, Lemieux and Chen deal with performer creativity from the musical perspective in this volume (Chapter 11).

10.2 Culture-specific aspects of creativity in performance

Prior to beginning any practical investigations of performance behaviour, it is necessary to highlight the power of cultural context in performance. Davidson and Good (2002) noted, for example, the socio-cultural mediation of interpersonal behaviours on stage, resulting in specific performance outcomes. Examining the rehearsal process and performance of the student members of a newly formed string quartet, they discovered that the dominance of the second violinist – the only male in the group – shaped the way in which the music was presented. This was somewhat affected by an underlying sexual dynamic between the second and first violinists.

With a sociological focus, Frith (1996) investigates the role of individuality and personal style in pop performance by considering how performers present themselves and how that presence is apprehended and used in a communication between performer and audience. He discusses how performer behaviours – including how clothes are worn – may be defining features of performance "success" and regards them as components where performers can be more or less inventive, communicative, individualised, and therefore creative. Davidson (2001) adds to this, demonstrating in an analysis of Annie Lennox's vocal performance that the performer can come in and out of contact with co-performers and audience by playfully using both singing voice and the body in a range of performance behaviours: for example, holding a single note for a long time and gesturing with a hand signal that this is a difficult, skilful task; or raising arms for dramatic impact to encourage audience participation.

The research discussed above suggests that, subject to their performance tradition, performers who manipulate the socio-cultural elements of their presentation strongly affect their audience's apprehension, pleasure, and understanding of the work. In the section that follows we explore the existing literature to suggest which specific behaviours in particular might be more or less relevant within a specific tradition. We do this by highlighting two different genres of vocal musical performance, jazz and classical. We have selected these as the first author is an opera singer and the second author is a jazz singer; we thought that our personal interest and expertise in the two domains would aid our exploration.

10.2.1 Interpretations of the musical material

A number of music researchers (e.g., Chaffin *et al.*, this volume, Chapter 11, and Berliner, 1994) have presented robust data showing how classical and jazz musicians consistently apply similar rules to the execution of musical

syntax (slowing at phrase boundaries, for example) in order to make their performances expressive. In vocal music, lyrics are given emphasis in various ways: stressed notes, *sotto voce* (suddenly getting quiet on a note), *portamento* (sliding between notes) etc. There are culturally defined rules about how to employ expressive devices, with a Baroque aria requiring more articulation than a Romantic Lied which emphasises *legato*. Jazz stylistic variation includes differing amounts of delay and acceleration: that is, getting ahead of or behind the beat of the music (see Berliner, 1994). While classical singing involves using an optimised, even vibrato tone and full resonance, jazz can vary somewhere between speech and singing. Also, jazz singers tend to perform largely in the middle or lower part of their voices and then – for dramatic effect – either drop very low or rise very high through a variety of means: scatting (imitation of an instrument, in often rapid scalar passages of improvisation), octave leaping. Thus, classical and jazz singers deal with musical expression by manipulating musical syntax, but they work rather differently, according to their stylistic traditions.

10.2.2 Stage behaviour

Classical music research has shown that the singer's creativity is how she combines vocal skills with stage behaviour. For instance, Davidson and Coimbra (2001) discovered that expert judges were very consistent in their appreciation of musical and visually expressive features of classical performances they were assessing. They were looking for the performance to be "touching", and searched for "multi-layered poised sincerity in music and body". The body needed to display "freedom of movement", and to have "energy flowing over the entire surface". When the performers did not live up to socio-cultural expectations about visual appeal, the judges were harsh in their comments. For example: "Odd make-up and ill-fitting cardigan", "a rather puppet-like physical appearance", "very oddly splayed feet". Where visual elements were pleasing, comments such as "a charming presentation" and "confident, professional feel" dominated. Judgements were being made about the performer's sense of self and personality in terms of non-verbal information; for example: "a self-possessed beam, with a strong performance personality". Clearly, judgements are made of jazz performers too, though research analogous to Davidson and Coimbra's work has not yet been undertaken.

So, stage presentation in the form of non-verbal information expresses musical intention, performer style and individuality. It is potentially the single most critical communicative force between co-performers, and performer and audience, providing information to enable musical coherence and giving insight into performers' internal states – whether nervous or calm, experienced or not. It will evidently have an important role to play in the investigation of performance creativity.

Furthermore, the two styles of music tend to be received differently by

the different types of audience. In classical contexts, audiences are typically passive, quietly observing the performer. In jazz, there can be a more active engagement, with audience members applauding solos, foot tapping, even dancing along to the music. Thus, within the different socio-cultural performance contexts we would expect differences. But within these, would there be key behaviours that make one performer more obviously creative than another? Or, would it simply be that the expressive elements would be more or less effectively communicated through a consequence of musical and bodily/social skill?

We now present the results of an exploratory study that aims to begin to answer some of these questions. As this is within a book chapter, we present only details of the study which are relevant to the specific focus here.

10.3 Preliminary exploration of performance behaviour creativity in jazz and classical solo singing

We decided to focus our study of performer creativity by asking singers to prepare "Summertime", the lullaby aria from the opening scene of the opera *Porgy and Bess* by George and Ira Gershwin and DuBose Heyward, completed in 1935. This was chosen as it is a well-known operatic aria, often used by female opera singers as an *encore* in solo recitals. In jazz, *Summertime* has been commonly performed and is recognised as a *standard*, appearing in most mainstream jazz repertoire. Thus, it was likely that performers would know the work, and equally, they would have strong ideas about how to perform it, and audiences would also have ideas about how to receive it.

Musically, it comprises a simple form: instrumental introduction, sung verse, bridge, sung verse, instrumental ending. The melody winds around standard V-I harmonic progressions and so is culturally predictable and repetitive. In the opera, the piece appears in B minor, lying in a high lyric soprano range, but in most commercially available collections of Gershwin's vocal music, it tends to appear in A minor, thus keeping in a mezzo-soprano range (mainly the E3–E4 octave range). All our classical singers sang in A minor, but the jazz singers preferred to sing in either F or E minor, pulling the work into a lower register. We refer readers to the opera score for an idea of how the music was played for the classical singers. In the jazz version, there was some variability in how the music unfurled, according to certain improvisational elements typical of the style, but it did remain within the overall form described above. In order to guide the reader through the rest of the paper, we recommend that a commercially available score is used. In all cases, the lyrics are those of the original aria, sung in the usual v1–v2 sequence.

10.3.1 Participants

The participants in the study were 10 female singers aged between 22 and 44 years of age (mean 36.6 years), with professional experience ranging from

one year in the case of the two youngest singers to 25 years in the case of the eldest singer participating. To respect the privacy of the participants, we have given them all pseudonyms. These are as follows:

- classical singers – Sophie; Julie; Kathy; Katie; Sally;
- jazz singers – Natalie; Jenny; Maggie; Lizzy; Maria.

Mark (his real name), a pianist, aged 27 years, with five years of professional experience, accompanied all the singers. Mark was specially selected for his uncommon and equal ability in both the classical and jazz domains. Also, Mark speaks very easily about his thoughts and feelings. Not only did he provide an element of consistency in the study (as he was the only other performer present), but he was also able to interact with the singers musically and socially. His feedback was therefore regarded as being critically important to the research process.

All singers were asked to participate one month prior to a performance session taking place. At the session, all singers were asked to sing to a video recorder in the presence of Mark (accompanying) and a camera operator, understanding that the recording would be shown to audiences. The singers were informed that we were investigating solo performance and were asked to practise and memorise "Summertime" for the recording sessions. The study took place in a large room with piano and began with a rehearsal condition, allowing the singer to practise and familiarise herself with the pianist and performance environment. The classical singers were then asked to give three renditions of the song. The jazz singers also gave three renditions and negotiated with Mark in choosing the desired key, style, and tempo: swing or ballad forms. The singers were asked to perform to the video camera and to regard the renditions as performances, without stopping. The video camera was placed at a slight angle to the pianist and singer, so that they could be seen in a combination of full-face and side-profiled positions, thus optimising the amount of movement data collectable from a single camera. Both the singer and pianist remained in camera shot throughout the recording sessions. The camera operator stood quietly behind the camera. After the recordings, each participant was interviewed about her experience. The interviews were informal, working from an open-ended schedule and asking simple questions about expression, intention, and assessment of the execution. The sessions took approximately one hour per singer. Mark was also interviewed, and was asked specifically to discuss which elements of the performance he liked or disliked, and why.

10.3.2 Data analysis

Several forms of analysis were used on the data collected, including Interpretative Phenomenological Analysis of the interview data (see Smith, 1995, 1999), and Bakeman and Gottman's (1986) principles of video analysis. The

first author of this chapter was very familiar with these types of analysis, having used them in combination in previous studies (see Davidson, 1991, 1997, 2002; Davidson & Edgar, 2003, for example).

The interview data were explored for emergent themes related to performer expression, style, and individuality, while the video observations aimed to describe what was happening. Our descriptors were taken from previous work by the first author and the general social psychological literature on non-verbal communication.

- **Looking/gaze** (Argyle, 1979; Davidson, 2001; Exline, 1963). Specifically: the performer would signal her status in relation to the audience and co-performer through direction of gaze.
- **Facial expressions** (Aguinis, Simonsen, & Pierce, 1998). Specifically: degree of overall facial tension to communicate different levels of credibility and expertise.
- **Relationship between vocal sounds and bodily gestures** (Davidson, 2001; Zeller, 1999). Specifically: a range of head, arm and hand gestures used for expressive ends, e.g.:
    - *Emblematic representations* of words, musical phrases or the actions implied (e.g., John Lennon's use of his index and middle fingers raised in a v-sign to symbolise peace in his performance of the song "Give Peace a Chance").
    - *Illustrative emphasis*; for instance, making an arm-rocking gesture when talking about a baby. These are far more universal and are used often subconsciously.
    - *Adaptive actions*. These are personal characteristics such as head scratching or chin rubbing and typically display inner states, and/or are used as self-comforting or controlling mechanisms. They are usually completely unconscious actions.
    - *Regulatory actions*. These are used for coordination and direction: for instance, making a downward arm gesture to coordinate the action "let's start together . . . now!".
    - *Display*. These are dissociated from the meaning of the sung material, and are instead concerned with "showing off" to the audience.

To explore these musical and movement codes, the two authors worked independently making observations, and came together to share results and related discussion. Mark was then invited to examine the data and provide feedback on the two judgements. Finally, a third party acted as an *auditor*: an expert judge and professional singer of both jazz and classical repertoire. This person was asked to verify the extent to which the interpretations were representative of the data presented to Mark. Where this provoked disagreement, discussion ensued until a final position was agreed. The

analytical principles were consistent with those outlined by Bakeman and Gottman (1986).

In addition to the analyses discussed here, we also assembled video clips of each performer for external evaluation, but there is no space to report these data here, other than to mention that Likert ratings (1–7) made by a range of judges directly support Mark's individual assessments of each performer.

10.4 Discussion

There is an initial and critical point to be made before we discuss the observed performance behaviours: the interview data revealed that of the classical singers, Mark preferred the performances of Julie and Kathy. Of the jazz performers, he favoured Jenny and Natalie. His least favoured performers were Katie (classical) and Maggie (jazz). It is also important to point out that greater age did not correlate with higher ratings; indeed, Katie and Maggie were two of the older participants. A brief general analysis of the performers' musical and vocal features gives us some basis for understanding Mark's selection.

10.4.1 General musical points

As expected, there were stylistic vocal differences, with the classical singers using a bright, open vocal tone throughout; *vibrato* on held notes for tonal colouring effects; both ascending and descending *portamento*; mainly a *legato* style with *rubato* at phrase ends; and the words were generally very clearly articulated. The jazz singers all applied a husky or breathy tone. In comparison to the classical singers, they generally used more *rubato* and more *staccato*, but far less *portamento*.

Mark's favourite classical performers, Julie and Kathy, were the only two to use a full range of dynamics from *p* to *f*. Also, these two singers were more "punchy" in their articulation of some words within the overall *legato* style. Mark's preferred jazz performers, Natalie and Jenny, both used a wide dynamic range, and *vibrato* for subtle tonal colouring effects. Katie, perceived by Mark to be the weakest performer overall, used inconsistent *vibrato* and lazy diction. In fact, it seems that she was less well equipped technically to interpret the aria. In summary, the most varied performances in terms of their musical expression were the ones regarded by Mark as the best performances. From these data, we might conclude that those able to use musically appropriate stylistic effects more subtly are more highly regarded, and this level of subtle interpretative skill seems to be consistent, irrespective of vocal style. We therefore have a means of suggesting what constitutes a better "musical" singer in this context. However, our study is primarily dedicated to stage behaviours, which we shall now discuss.

10.4.2 Stage presentation: Dress

All the women dressed with the knowledge that they would be observed. Julie, Kathy, Katie, Sally (all opera singers) wore the most formal and smart clothing (dresses or two-piece suits). Sophie was an exception in the classical group, choosing to wear jeans, but she was 10 years younger than the others on average, and may not have been subjected to the same cultural agenda. Natalie, Maggie, and Lizzy wore hippy-style blouses and either denim skirts or jeans, perhaps characteristic of the women in their late-30s singing jazz. Maria, 10 years younger than the other jazz singers, wore much more tight-fitting sexy clothes: a sleeveless top and jeans. Jenny, in her mid-30s, wore the most formal clothing of the jazz singers, a simple business-style dress.

Broadly speaking, the clothing worn was representative of the stereotypical cultural image of female singers in the classical and jazz styles.

10.4.3 From face to body: Stage behaviours

10.4.3.1 Eye movements and facial expressions

UPWARD GAZE

A common behaviour shared by all the classical singers was the use of upward gaze, which was used for seemingly dramatic effect to suggest: (a) thoughtfulness and reflection; (b) listening to both the music and perhaps the child. It most commonly occurred during the piano introduction of the aria, perhaps as a device to focus and prepare to sing. Similarly, when this musical material returned to introduce the second verse, the gaze recurred, suggesting contemplation or, as before, preparation. Three of the five opera singers looked up and outwards during the walking-bass figure that signalled the conclusion of the work.

Among the jazz singers, upward gaze was used only in the swing version. Both Lizzy and Natalie did this at the opening of the aria. There was no evidence of this kind of gaze in the ballad version.

It became apparent that stylistic issues caused the difference in the use of upward gaze. The classical singers appeared to connect directly with the dramatic narrative of the aria's lyrics, whereas the jazz singers worked more with the musical style than with the song's lyrical content. This point is elaborated in the next category of facial expression.

CLOSING OF EYES AND FROWNING

The classical singers generally kept their eyes open and tended to look up (as mentioned above). However, at some individually variable time, all closed their eyes for the greater part of the phrase "an'd the livin' is easy". There are two possible reasons for this: (a) accommodating the feeling of relaxation as the vocal demands decrease when the melody descends from its initial high

note entry on the first word, “Summertime”; (b) a dramatic empathy with the word “easy”, the closed eyes perhaps being representative of the relaxed nature of an easy lifestyle. The second occasion this occurred was at the end of the second verse, when the singer delivers the line “with Daddy and Mammy standin’ by”. The eyes close on either “standin’ ” or “by”. Since the melodic line drops even further in pitch, representing the end of the piece, the notion of relaxation might also explain the closing of the eyes.

By contrast, the jazz singers frequently closed their eyes throughout the performances. In both swing and ballad versions we noted that the eyes closed at phrase endings, many of these locations being similar to those of the classical singers: for example, at the phrase endings, “. . . livin’ is easy”, “. . . cotton is high”, “So hush, little baby”, etc. The eyes were closed more in the ballad versions than the swing, with the face either screwed up or often using a very deep frowning position. We interpreted this as a facial *pose* used to illustrate pain, sorrow, and effort.

SMILING

Smiling was used by all the classical singers, particularly in the introduction and the instrumental bridge between verses 1 and 2. This expression corresponded with the aria’s narrative: (a) looking affectionately at the baby during the introduction; (b) the feeling of hope anticipating the second verse words, “One of these mornin’s you’re gonna rise up singin’ ”. It is important to note that in classical singing technique great emphasis is placed on the singer focusing their concentration into the resonance cavities in the facial sinuses, which can result in the half-smile appearance. Places where the smiling seemed to be more technically than dramatically oriented were on the words “livin’ ” in verse 1 and “singin’ ” in verse 2. This was largely – it seems – to keep the vowel sound bright and focused forwards.

This dramatic and technical interpretation is in stark contrast to what the jazz singers do. None of them smile, the whole interpretation being based around intense frowning or downward eye glances.

RAISED EYEBROWS

Occasionally in the swing version, the jazz singers raised their eyebrows in a manner that corresponded to the song’s lyric; for example, on the lines connected with the child going out into the world: “. . . spread your wings”, “An’ you’ll take the sky”. The classical singers raised their eyebrows at very specific locations: firstly on the initial word “Summertime”, then on “Fish are jumpin’ ” in verse 1 and then “One of these mornin’s” in verse 2. We interpreted the general use of the raised eyebrow again to be an example of a technical tool. Each time it occurred the singer had to enter a new vocal phrase on a high pitch – the highest pitch of the song. The eyebrow lifting seemed, psychologically at least, related to creating space at the back of the

throat, opening the soft palette and allowing the vocal folds to move freely, as the air was expelled through them.

EYE-CONTACT WITH PIANIST

Of the classical singers, only Julie used direct eye contact with the pianist. This seemed to act as a cueing device to indicate her vocal entry. Despite the overall lack of eye contact among the classical singers, Mark commented that Kathy, in particular, was very easy to work with due to her general body awareness, which seemed to facilitate coordination with him and the audience simultaneously. During the detailed video analysis, for instance, it was observed that Kathy positioned herself directly facing the camera. Although the cues she offered Mark for timing coordination were essentially delivered forwards to the audience, Mark was easily able to interpret these signals from the rear of her back, head and arms.

The jazz singers, by contrast, used a lot of eye contact with the pianist in the swing version, much in the same way Julie had done. Indeed, Jenny often turned completely around to look at the pianist for entrance cues.

In addition to these facial movements, many head and body movements contributed to the performance.

10.4.3.2 Head and body movements

HEAD NODDING AND SHAKING

Head nodding and shaking were used consistently by the classical singers in the same two places in the piece. The first occurred on the line "an' the livin' is easy" in verse 1, and the second on "One of these mornin's" at the start of verse 2. In these two cases it seems that this gesture shows agreement with the words, as a point of both clarification and commitment to the ideas. Head shaking was used by the same three singers, specifically on the line "there's a nothin' can harm you". The purpose once again suggests an emphasis of the meaning of the lyric. The shaking is clearly representative of a *no* statement, whereas the nodding seems indicative of a *yes* statement, and so both parallel the gestures typically used in speech to emphasise these words.

The jazz singers used these expressions less frequently. Natalie and Lizzy appeared to use the nodding in the same manner as the classical singers. Maggie frequently shook her head, but her intentions seemed to differ from those of the classical singers. The shaking seems to be a response to the sounds of her own voice, rather than of the song's lyric.

LEANING AND SWAYING HEAD AND BODY

All the classical singers combined a forward leaning head and upper body movement. This occurred in all the performances during verse 1, line 1, on the

word "easy" and in line 4, on the word "hush". Again, this may be representative of the text, suggesting a conscious attempt to express the narrative. It may also be due to the low pitch of the word in the context of the melodic line, as the singer leant forwards and downwards with the falling pitch of the phrase ending.

A backward body and head movement was evident in verse 1, line 2 on the words "Fish are jumpin' ", and ironically on the line "rise up singin' " at the beginning of verse 2. It seems strange at a narrative level that the singers should move back, away from words connected with upward movement. We could simply accept this finding as an anomaly. However, we know from vocal technique that singers are taught to feel diaphragmatic pressure deeper or lower, the higher they sing. These particular instances occur when singing at the highest pitches and so there is a need to feel a deep level of support for the correct projection of the notes. Additionally, it makes complete physical sense for the singers to move back having just surged forward on the preceding lines.

The points made above about leaning relate directly to an observed circular motion body sway. All the classical singers engaged in this more or less during their performances. However, sometimes it was only obvious in the pronounced leaning movements described above, and it is because of this that we have included leaning as a separate category of gesture. Sometimes it was such a small movement that it was visible only as a very subtle shifting of weight from one side of the body to the other – rather like a very controlled and small-scale lilting action. This relates to the rhythmical aspects and concept of a lullaby – the singers lulling or rocking the baby – and indicates how they perceive and react to the text and musical content. Moreover, the swaying, at times, became much larger and fluid, especially in the solo piano sections. At one level, this may have been because the singers were physically freer to move their bodies in response to the music, but equally it could have been a more deliberate effect to communicate with the audience – dancing to them, perhaps.

Considering the jazz singers, the abovementioned interpretation fits perfectly. Throughout the swing version, they swayed and bounced, making circular body movements, in a clear and corresponding rhythmic pulse. In the ballad form, similar leaning to that of the classical singers was observed. Consequently, the swing version appeared more extravert, the ballad more reflective.

ARM MOVEMENTS

In the classical performances the singers began some movement patterns with the arms in the musical introduction, initially raising them sideways and upwards towards a position where the forearms were level with the shoulders. All lowered their arms during the closing piano section, when the singing had ceased. It therefore seems that the arm raising was illustrative of the voice coming into use and the singer herself coming into contact with the audience.

One singer, Sally, however, used a series of static poses. She began with a fixed body pose with her right arm on her chest and hand resting on her left collar-bone. Her left hand rested on her hip, arm bent at the elbow and pointing backwards. She held this position until the middle of verse one. Then on the line "And the cotton is high" she gradually unfolded her right arm forwards and down, until the last line of the verse when she relaxed her right hand by the right thigh. At that point, during the bridge section, the left hand was also released and lowered to the left thigh. When verse 2 began, both fists clenched on ". . . mornin's", and ". . . rise up singin' ", then re-clenched on ". . . wings" and ". . . take the sky". The arms opened and the hands made a small symmetrical gesture fanning outwards. Then the fists re-clenched and the hands asymmetrically rose on ". . . nothin' can harm you". She held this pose until her singing ceased.

In all cases all the singers seemed to use stereotypical illustrators of certain concepts:

(1) scooping as if picking up a child;
(2) leaning forwards and upwards as if offering help and support;
(3) stroking, palms facing downwards movements, like stroking the child;
(4) pointing as if pointing to the child, to the future, and even to the audience to include them all;
(5) arms opening in a wing spreading and taking flight action as the child takes off on life's journey.

In the jazz performances, gesturing and posing also related to the narrative of the lyric, particularly in the ballad version on the lines ". . . spread your wings" and ". . . take the sky". However, the singers seemed rather more concerned about the style of performance, such as holding the microphone in a particular manner, using stylistic dancing patterns with the body and arms and frequent use of finger clicking in the swing version. Again, we see a strong stylistic difference between the classical and the jazz performers: narrative of the song's lyrics versus the presentation of the particular musical style.

So far, we have noted several points of commonality and contrast, indicating stylistic profiles and individual profiles. Indeed, among our data we have some indications about what might constitute a typical stylistic performance not only in terms of musical expression, but now from the stage behaviours too. Julie and Kathy, for example, work with the narrative of the aria, using poses and gestures, but maintain fluent body movements. Sally, a great singer technically, but not rated well as an interpreter by Mark, uses much stiffer and fixed poses. Natalie and Jenny move fluently, swaying and frequently looking at the pianist to exchange information. They dance, click their fingers and make fluent gestures. In all these cases there is evidently a strong physical awareness and confidence in the use of the body.

Overall, we see that some of the results were indeed anticipated. Clothing

was obviously well considered, sending out a specific cultural message about age, sex, and role. There were matters related to specific style and vocal technique: smiling as opposed to frowning, for instance. Perhaps the most striking stylistic difference was that the classical singers focused on the lyric of the song for interpretation, whereas the jazz singers were driven by the rhythm (finger clicking and dancing), and the mood of the style – whether swing or ballad. It seems that all the singers were active in their vocal and bodily behaviours. Mark's preferred singers appeared to be those who were completely fluent in their performance behaviours: constantly moving, showing the audience the music was "inside them", and, perhaps more significantly, showing that they were in control of their behaviours. It is in our final analysis, however, that we believe we are able to demonstrate a new insight about performance behaviour across the two different styles of performance.

Tables 10.1 and 10.2 summarise the different types and numbers of gestures made by each singer. Note that Natalie and Maggie did not offer "slow ballad" versions of "Summertime". These are as follows: illustrative of an element of the song's lyric or the melodic contour; adaptive gestures, showing some personal and self-referencing movement like touching the face with the hand or rubbing the lobe of the ear with the thumb and forefinger; regulatory in terms of coordinating the turn-taking of the singer and pianist; technically regulatory such as making a movement that is clearly to aid the vocal quality, e.g., lifting the hand in an arching shape mirroring the action of the soft palette; or display behaviours such as "showing off" to the audience. Note that none of the performances revealed any emblematic gestures.

Several points are immediately striking.

- The more highly Mark rated the performer, the more gestures were made, with Jenny totalling 126 gestures in her ballad performance, and Maggie (regarded as the weakest jazz performer) totalling only 35.
- The better regarded performers make proportionally more illustrative and adaptive gestures than any other kind of non-verbal behaviour.
- Contrarily, the higher the proportion of technical regulators and display gestures in a performance, the less highly regarded the performer (Sally has many display gestures, more than ones illustrative of the song's content, and she is regarded as a "stiff" and "uninspiring" performer by Mark).
- Jazz and classical singers make similar proportions of these movement types, irrespective of the musical style.

These findings are important, for they indicate that performers not only move a lot and illustrate their interpretative ideas, but also reveal intimate personal behaviours in their adaptive behaviours. We have interpreted these results to imply that a balance between what we might consider *outer projected* and *inner personal* states is achieved, and this may be a critical indicator of the more accomplished interpreter. The adaptor itself seems to be a spontaneous

Table 10.1 The jazz singers' gestures for the swing and ballad versions of "Summertime"

Singer		*Illustrator*	*Adaptor*	*Regulator*	*Technical regulator*	*Display*	*Total*
Natalie (swing)	Posture/Body	10	14	3	3	2	**32**
	Hands/Arms	8	9	2	–	2	**21**
	Eyes/Face	7	1	4	9	3	**24**
	Total	**25**	**24**	**9**	**12**	**7**	**77**
Jenny (swing)	Posture/Body	14	18	7	2	2	**43**
	Hands/Arms	24	6	4	–	5	**39**
	Eyes/Face	5	3	7	12	3	**30**
	Total	**43**	**27**	**18**	**14**	**10**	**112**
Maggie (swing)	Posture/Body	5	13	5	–	–	**23**
	Hands/Arms	–	–	1	–	–	**1**
	Eyes/Face	6	–	5	–	–	**11**
	Total	**11**	**13**	**11**	–	–	**35**
Lizzy (swing)	Posture/Body	9	12	1	–	1	**23**
	Hands/Arms	13	9	2	–	1	**25**
	Eyes/Face	13	4	–	18	3	**38**
	Total	**35**	**25**	**3**	**18**	**5**	**86**
Maria (swing)	Posture/Body	9	13	8	2	2	**34**
	Hands/Arms	9	11	7	–	4	**31**
	Eyes/Face	3	7	4	7	2	**23**
	Total	**21**	**31**	**19**	**9**	**8**	**88**
Jenny (slow ballad)	Posture/Body	19	18	12	8	1	**58**
	Hands/Arms	22	3	6	–	4	**35**
	Eyes/Face	6	2	9	12	4	**33**
	Total	**47**	**23**	**27**	**20**	**9**	**126**
Lizzy (slow ballad)	Posture/Body	11	14	1	–	–	**26**
	Hands/Arms	4	1	1	–	–	**6**
	Eyes/Face	6	–	3	6	4	**19**
	Total	**21**	**15**	**5**	**6**	**4**	**51**
Maria (slow ballad)	Posture/Body	5	11	7	–	2	**25**
	Hands/Arms	7	4	4	–	7	**22**
	Eyes/Face	6	2	4	2	3	**17**
	Total	**18**	**17**	**15**	**2**	**12**	**64**

personal reflection in the moment, rather than a stereotyped, rehearsed behaviour.

Our data, considered together, reveal several characteristics both linking and differentiating the 10 singers and their musical styles.

- A focus on the specific musical elements in each musical style: classical singers working with the lyrics and melodic line; jazz singers working with the musical "groove".
- Physical gestures, rather than fixed and static poses or postures, are preferred across singers and styles.

Table 10.2 The classical singers' gestures in their performance of "Summertime"

Singer		*Illustrator*	*Adaptor*	*Regulator*	*Technical regulator*	*Display*	*Total*
Sophie	Posture/Body	10	16	2	3	1	**32**
	Hands/Arms	15	–	3	–	–	**18**
	Eyes/Face	2	–	2	6	7	**17**
	Total	**27**	**16**	**7**	**9**	**8**	**67**
Julie	Posture/Body	12	8	6	4	1	**31**
	Hands/Arms	10	5	1	–	2	**18**
	Eyes/Face	6	–	2	5	7	**20**
	Total	**28**	**13**	**9**	**9**	**10**	**69**
Kathy	Posture/Body	13	11	2	3	–	**29**
	Hands/Arms	12	1	1	–	4	**18**
	Eyes/Face	4	–	6	2	5	**17**
	Total	**29**	**12**	**9**	**5**	**9**	**64**
Katie	Posture/Body	9	10	3	–	–	**22**
	Hands/Arms	–	1	–	–	–	**1**
	Eyes/Face	8	–	3	2	4	**17**
	Total	**17**	**11**	**6**	**2**	**4**	**50**
Sally	Posture/Body	6	2	1	2	7	**18**
	Hands/Arms	6	2	–	–	4	**12**
	Eyes/Face	1	2	3	–	3	**9**
	Total	**13**	**6**	**4**	**2**	**14**	**39**

- The use of stylistic and technically appropriate gestures relating to the communication of emotion is important – classical singers tending to make the activity look easy, and jazz singers tending towards the act of singing being effortful.
- A fluent and cohesive swaying behaviour is apparent in classical and jazz singing, apparently to integrate all the physical gestures.
- The more highly regarded the performers, the more prevalent their use of illustrative and adaptive gestures rather than display or technical regulators.

Of the factors identified above, the sway is perhaps, as Davidson (1997) has argued, illustrating a central integrating means for expression through the body. So, fluent movement might imply a more coherent conception of the musical work and its meaning for the performer. The flow found in the swaying perhaps integrates the performance, and additionally aids the perception of the individual effects such as illustrations of narrative content. Mark and the judges suggest that the performers who sway are more effective musical communicators.

Referring back to Webster's (1990) initial definition, if creativity is concerned with the subtle and novel manipulation of culturally specified rules about music and the behaviours involved in presenting that music, through

our analysis we have identified several key cultural and stylistic elements that these singers used, some more appropriately than others, and that are dependent on skill level. But what of the individual inventiveness and unique contribution? Was one performer more creative than all the others?

Turning again to Mark's comments, he regarded Jenny as the most "daring and inventive", and thus the most creative of all 10 performers. He claimed that this depended on the following:

- she was very skilled as a musician;
- she was very fluent in all her musical and social behaviours;
- thus, she could express herself as she desired;
- her ability to interface both bold and intimate bodily and musical effects; seemed to make her stand out.

This single report is a subjective and tentative indicator of what may have been more creative in the performances of Jenny. However, the identification of both the boldness and intimacy of Jenny's behaviour does support the results of the movement analysis, indicating that the more highly regarded performers used both illustrative or "outwardly focused" gestures and adaptive or "intimate" gestures. Self-presentation might, indeed, function as a critical factor in creative performance behaviour. This finding can be linked to a discussion of the performer's *persona*. The term "persona" was coined by Carl Jung, who argued that each individual possesses a number of different *masks* to protect the "core self". An individual spends time in social contexts (through conscious and unconscious means) learning how and when to use appropriate masks for public and intimate discourse.

Davidson and Coimbra (2001), in their study of classical singers taking examinations at music college, discovered that judges depended to a significant degree on non-verbal information to decide whether or not the singer was presenting an "appropriate" version of themselves (their use of the term). They spoke of the classical singers "projecting" an appropriately extravert version of themselves for the public context of the performance. Davidson's (2002) analysis of her own performances led her to the discovery that her performance behaviours (gaze, hand gestures, etc.) were generally larger and so were perceived to be more extravert and thus confident than those she adopted in a small group and one-to-one social encounters. But Davidson and Coimbra (2001) also found the judges looking for "heartfelt", "personal expressions" on the stage. Their view of a "truly original interpretation" was one that was "intimate and personal, getting to see the real person as well as the show".

10.5 Conclusions

The novelty of the findings presented in this chapter is that the adaptor gestures used seem to be helpful in the production and appreciation of

performance quality, and these are "intimate and self-disclosing" gestures. It might be that in order to be a creative performer, the singer needs to balance musical skill and inventiveness with extravert stage presence and intimate behaviours. The data reveal, of course, that these personal behaviours need to be appropriate to the musical style being sung. Thus, we might propose that besides technical and expressive musical fluency and sensitivity to musical style, fluidity of movement behaviour in extravert illustrative gesture is necessary. But we would emphasise also the importance of adaptive, intimate gesturing for optimum performer communication – revealing inner as well as outer communicative concerns. Thus, we would build on Webster's (1990) definition of creativity to suggest that socio-cultural knowledge and understanding include individual behavioural knowledge, sensitivity, and the optimum communication of these elements in performance.

This chapter has only begun to explore the rich data and the many theoretical possibilities emerging from our investigation of singers. But it clearly illustrates the wide range of skills necessary to be a performer, and hints at which stage behaviours might contribute to performer creativity. While this chapter focuses on the individuals and groups studied, it is recognised that many of the issues raised may be similar for performers of other musical traditions and instruments, and different sized musical ensembles.

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11 Spontaneity and creativity in highly practised performance

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11.1 Introduction

Musical performance in the Western classical tradition is generally considered to be a creative activity (Clarke, 1995; Gabrielsson, 1999; Neuhaus, 1973; Persson, 2001). At the same time, performances are prepared and practised to the point that the motor skills involved become automatic. Nuances of timing, trajectory, speed, and force become highly stereotyped and are repeated with minimal variation from one performance to the next (Seashore, 1938; Shaffer, 1984; Shaffer, Clarke, & Todd, 1985). There seems to be a contradiction here. How can a performance be both creative and highly automatic at the same time? Pablo Casals tells us that, after the many hours of hard work needed to prepare a new work for performance are over, "The work of preparation ruled by discipline should finally disappear, so that the elegance and freshness . . . strike us as being spontaneous" (Corredor, 1957, p. 204). How does the performer do this? How can a highly automated performance be spontaneous; or is spontaneity simply an illusion created by a skilled performer?

We believe that spontaneity in performance is not an illusion. Even though soloists in the classical tradition generally strive to reproduce the same interpretation from one performance to the next, repeated performances generally differ in small but musically significant ways. As Emil Gilels reports, "It's different each time I play." (quoted in Mach, 1991, vol. 2, p. 123). This kind of spontaneous variation can be viewed as a form of *musical creativity*, although we would not disagree with anyone who preferred to talk of *musical spontaneity*. Performers adjust to the idiosyncratic demands and opportunities of each occasion. For example, if a concert pianist is faced with an unresponsive instrument or the acoustics of the hall are poor, rather than struggling to bring out all the refinements of interpretation that have been prepared, the soloist may choose to give more emphasis to larger gestures and downplay more subtle effects. The creativity involved in this kind of spontaneous micro-adjustment of a highly prepared interpretation makes each performance a creative activity, separate from the creativity involved in preparing the interpretation in the first place. The possibility of this kind of

musical creativity is surely one reason that live performance continues to be valued in an age when high-fidelity recordings might otherwise eliminate the need for it.

Not that spontaneity during performance is the most important source of musical creativity. At least in the Western classical tradition, by far the most significant creative activity takes place in the privacy of the practice studio when an artist first settles on a particular interpretation, making the myriad decisions about trajectories, timing, speed, and force needed in order to convert the abstract representation of a piece of music in a score into the physical reality of a performance (Clarke, 1995; Gabrielsson, 1999; Neuhaus, 1973; Persson, 2001). These nuances of execution make each musician's interpretation of the same piece somewhat different (Clarke, 1988; Palmer, 1989, 1997; Snyder, 2000, pp. 85–90; Repp, 1992, 1998). The ability to create a unique and yet convincing interpretation is highly valued and performers' reputations depend importantly on how their efforts are appreciated and judged by audiences, critics, and promoters.

Here, however, we will be concerned not with the initial creation of an interpretation, but with its re-creation in successive performances. The performance must be automatic (Anderson, 1982; Fitts, 1964; Shiffrin & Schneider, 1977) to cope with the speed of response demanded by virtuoso performance and with the highly charged atmosphere of the concert stage. If actions are not as fluent and automatic as tying one's shoes, they will be swept away in the adrenalin rush of stepping out in front of an audience (Steptoe, 2001). But how then is the performer to achieve the spontaneity needed to "produce a vital performance . . . [and] recreate the work every time" (Pablo Casals, quoted by Corredor, 1957, p. 196)? If every nuance of interpretation has been practised over and over until it occurs automatically, how does a performer keep the performance fresh, adjusting to the special demands of each occasion?

The answer, we propose, is to be found in what the musician thinks about during the performance. If the musician is not paying attention to the music, then a performance can easily be automatic and lack the important qualities of vitality and spontaneity. Highly prepared performances can be delivered this way all too easily. Similarly, if the performer focuses on possible pitfalls and mistakes to be avoided, this also is unlikely produce a creative performance. On the other hand, if the performer focuses on interpretive and expressive goals, then a spontaneous and creative performance is possible. The small variations that inevitably occur in any performance will be shaped by the performer's musical goals and are likely to enhance the expressive qualities of the performance by adapting it to the idiosyncratic qualities of instrument, hall, fellow musicians, and audience.

Performers are able to modify their highly practised performances in this way because the performance is under the control of *performance cues* (Chaffin & Imreh, 1997, 2001, 2002; Chaffin, Imreh, & Crawford, 2002, pp. 169–173; Imreh & Chaffin, 1996/97). Performance cues are the landmarks

of the piece that a musician attends to during performance, carefully selected and rehearsed during practice so that they come to mind automatically and effortlessly as the piece unfolds, eliciting the highly practised movements. Performance cues become an integral part of the performance and provide a way of consciously monitoring and controlling rapid, automatic actions of the performance. They provide points of intervention at which the performance can be restarted when something goes wrong and where adjustments can be made in response to the demands of the occasion and the moment. Performance cues make it possible for the execution of a highly prepared, automatic skill to be a creative response to the demands of a particular performance.

During practice, a performer makes many decisions about basic issues (e.g., fingering, technical difficulties, patterns of notes), and interpretation (e.g., phrasing, dynamics, tempo, timbre) whose implementation becomes automatic with practice (Chaffin *et al.*, 2002, pp. 166–176). This allows the performer to select a limited number of critical features to pay attention to during performance, e.g., a tricky fingering or critical phrasing. Practising with these features in mind turns them into performance cues, features of the music that come to mind automatically as the piece unfolds, along with their associated motor responses. We distinguish three types of performance cues. (Other categorizations are possible but these have proved adequate in our research on piano performance.) *Basic performance cues* include critical fingerings, technical difficulties, and patterns of notes to watch out for. *Interpretive performance cues* include critical phrasings, dynamic emphases, changes in dynamic level and tempo, and use of the pedal. *Expressive performance cues* represent the musical feelings that the performer wants to convey to the audience, e.g., surprise, gaiety, excitement.

The different kinds of cue are organized in a hierarchy framed by the formal structure of the music (see Figure 11.1). While practising, a musician's attention shifts between the levels of the hierarchy, with most attention going to the level on which problem-solving efforts are currently focused (Chaffin, Imreh, Lemieux, & Chen, 2003; Clarke, 1988; Williamon, Valentine, & Valentine, 2002). Work on a new piece starts by taking account of all the levels in the hierarchy in order to develop an "artistic image" of how the piece should sound (Neuhaus, 1973; see Chaffin *et al.*, 2003). After this, practice time is mostly spent on lower level problems of technique and interpretation. In front of an audience, however, problems must recede into the background so that musical expressiveness can take centre stage, both in the mind of the performer and (as a result) in the aesthetic experience of the audience. This transformation is achieved during the final polishing for performance by attending to the expressive performance cues that represent musical feelings. Expressive goals are identified early on (Chaffin *et al.*, 2003), but in this final phase of practice the pianist practises playing with expressive cues as the main focus of attention. As a result, the musician learns to access the action hierarchy directly at the level of the expressive cues, making it possible to play

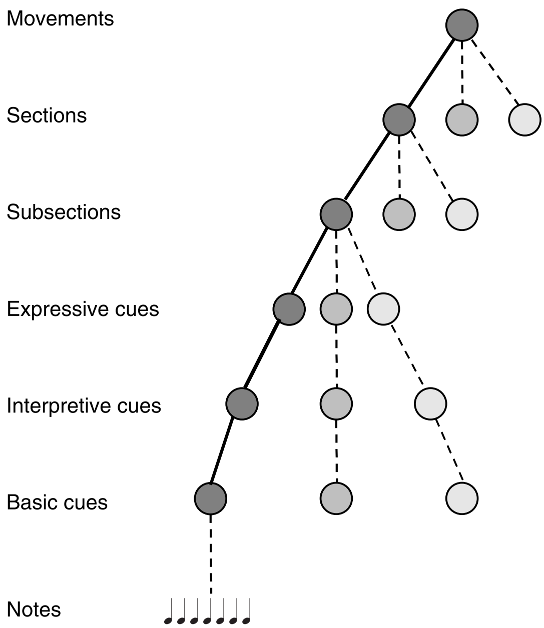

Figure 11.1 Schematic representation of the hierarchical organization of performance cues showing the three levels of formal structure identified by the pianist for the *Presto* and three types of performance cue.

with expressive goals in the spotlight of attention, while structural, basic, and interpretive cues form a penumbra on the edges of awareness, ready to be called on as needed (Chaffin & Imreh, 2002).

To test these intuitions, we observed a concert pianist as she prepared the third movement (*Presto*) of the *Italian Concerto* by J. S. Bach for performance. We have described the study elsewhere (Chaffin & Imreh, 1997, 2001, 2002; Chaffin *et al.*, 2002; Imreh and Chaffin, 1996/97), but have not previously discussed the issue of creativity in performance. Here, we review the study with the issue of creativity in mind and summarize new measurements of tempo variation during polished performances that are particularly relevant.

The pianist was Gabriela Imreh, a coauthor of previous reports of the study, who was learning the *Italian Concerto* for the first time for the professional recording of an all-Bach CD (Imreh, 1996). Gabriela identified the performance cues she used for the *Presto* and we looked at how these cues were established and developed over the months of practice. We will examine four types of evidence that the pianist's attention shifted from one type of performance cue to another as learning progressed. First, Gabriela commented, as she practised, about what she was doing, stopping briefly to do so. We will report four occasions when she described in some detail what she was

thinking about as she performed the piece. Second, starts and stops during practice provide behavioural evidence confirming these self-reports. Third, tempo fluctuations during polished performances indicate the location of performance cues and show that expressive goals were not always implemented in exactly the same way. Finally, later recall of the score provides a window into the way that the piece was organized in the pianist's mind when it was last performed.

11.2 Learning the *Presto*

11.2.1 Stages of the learning process

The pianist videotaped her practice from the first time she sat down at the piano until the piece was ready to record 33 hours, 57 sessions, and 42 weeks later (see Table 11.1).[1] The learning of the *Presto* can be divided into six stages, beginning with *scouting-it-out* during the initial sight-reading through the entire concerto at the start of the first practice session. Six sessions of *section-by-section* practice followed during which the pianist worked through the piece a few sections at a time, deciding on fingerings and working the music into the hands. There was then a break of a few days while the pianist worked on the first movement. When work on the *Presto* resumed in session 7, practice was organized differently, with every section of the piece being played at least once in each session. Gabriela called this the *grey stage* because her playing was at an uncomfortable, intermediate stage, not yet fully automatic, but fluent enough that efforts to consciously direct it sometimes interfered. The grey stage was interrupted after session 12 by the first of two long breaks during which the piece was not played.

The first break lasted for three months after which the piece had to be relearned, so that the next stage of *putting-it-together* did not begin until session 17. The new goal of playing fluently through the whole piece from

Table 11.1 Six stages in the learning of the *Presto*, showing the time practised, the distribution of sessions over weeks, and the location of the two long breaks

Stage	*Session*	*Duration (h:min)*	*Week*
Scouting it out	1	0:20	1
Section by section	1–6	6:00	1–3
Grey stage	7–12	4:59	3–5
BREAK 1			
Grey stage cont'd	13–16	2:51	20
Putting it together	17	1:02	20
Polishing	18–24	4:13	21–22
BREAK 2			
Polishing cont'd	25–44	10:05	30–40
Maintenance	45–57	3:55	41–42

memory was achieved in this one session. The next stage of *polishing* began in session 18 and continued in three phases over the next five months. Polishing for the first performance took two weeks (sessions 18–24) and ended with the pianist's first public performance of the piece as part of a recital programme. This performance was not, however, the end of the learning process. After taking a two-month break, she relearned the piece and polished it again (sessions 25–30). Preparation might have been complete at this point, but the pianist decided that the piece needed to go faster to make it "gel" (Chaffin *et al.*, 2002, p. 152), and sessions 31–44 were devoted to increasing the tempo. When the piece was finally ready, its high state of preparation was maintained for the remaining two weeks before the recording session with a final stage of *maintenance* practice (sessions 45–57) of which only two sessions (49 and 50) were videotaped.

Nearly three months later, as she was listening to the tapes of the recording session, the pianist wrote down all of the performance cues and provided reports of other features of the music (Chaffin & Imreh, 2001; Chaffin *et al.*, 2002, pp. 166–169). During the following two years, the pianist did not play the piece, and, 27 months after the recording session, she wrote out the first page of the score from memory.

11.2.2 Pianist's reports after practice performances at four stages of the learning process

The pianist's comments during practice document both the development of the performance cues for the *Presto* and the development of the *concept* of performance cues in her thinking. At the time that recording of practice began, the idea of performance cues had not yet been clearly articulated. The pianist and the first author of this chapter had recently presented a workshop together describing piano memory in terms of standard psychological constructs such as chunking, retrieval cues, and automaticity (Imreh & Chaffin, 1993). An opportunity to present the same ideas at a conference on practical applications of memory research the following year provided the impetus for the study (Chaffin & Imreh, 1994).

This is why, when the pianist completed her first performance of the piece without the score at the end of session 12, she took a few minutes to describe how she had done it. Opening the score, she went through it describing what she had been attending to during the performance just completed. She did the same thing again at the end of session 17, after learning to play from memory, and at the end of session 24, before the first "live" performance. Then, between sessions 31 and 32, she wrote out a more formal description of the same information for one section. These four occasions provide a picture of how her attention focused on different levels of the hierarchy of performance cues as learning progressed.

Session 12 was the end of the first learning period and the pianist was about to set aside the piece for several months. She had been using the score

during practice and now wanted to show, for the record, that she could play without it. Closing the score, she played through it twice from memory. During the first attempt she ran into trouble with the transitions between sections.

> Probably now the seams are quite obvious . . . It's going to take a while to get through this, but it's good [for me]. Now I have to check each transition [between themes] because each time it's something different. That's the second time, so . . . Oh, I confused them.

The description focused on the sections and subsections of the formal structure.

At the end of session 17, just after playing through the piece successfully four times in succession without the score, the pianist talked again about what was going through her mind as she played. The description was several times longer than that of session 12 and, while structure was still mentioned, most of the comments were about basic cues.

> Well, I have to tell you a few things. Eventually at this level you start to have a sort of map of the piece in your mind and you . . . focus on certain places in it. I'll try to tell you . . . I have a thing in bar 42 where I have to remember to go all the way to the G . . . I have to concentrate on the fingering in bar 65, the left hand divided between two, four fingers . . . The next place I have really planned to concentrate was, an old friend, bar 118. I have, oh boy, the scale in the left hand at [bar] 124, the two fours in a row.

Here we have examples of the three different types of basic performance cue – a technical difficulty (a [jump] in bar 42), a fingering (in bar 65), and a pattern of notes (the scale in left hand) – each needing attention during performance.

The third occasion was at the end of session 24, the day before the pianist performed the piece in public for the first time. The description was much more detailed than in session 17, and again the focus had changed. Now, most of the cues involved interpretation; basic and structural cues were hardly mentioned.

> And again the . . . double counterpoint that I've been working on ever since in bar 45. And then it changes in bar 49 – the hands switch roles . . . I'm doing a little bit of *ritard.*, just smaller than the other one in bar 75. I'm trying to bring out, in 77, the C's in the left and F in left hand. And I'm still trying to do a fairly aggressive . . . [plays], just in left hand. And then I return to very lightly *pianissimo*. And again, just the left hand B♭ (accented), and then I return to *pianissimo*. . . . And that gives me again room for a nice *crescendo* in 86 and on . . . I try to put the accents in. It's very hard. Most times I'm lucky, but in 93 I sometimes

miss that D below the staff. It's a big jump and it goes awfully fast. But I want to emphasize it because it's a theme.

Most of these are interpretive performance cues: phrasing (double counterpoint), tempo (*ritardando*), dynamics (*pianissimo*) and articulation (put the accents in).

It is interesting to note that, although the pianist was about to perform the piece in recital, expression is scarcely mentioned. The absence does not mean that the performance the following day was not expressive – expression was built into the automatic actions of hands and fingers – but it does mean that the piece was not completely ready yet. This was evident the next day when the pianist performed using the score, something she rarely does, and also in the more than 10 additional hours of practice on the piece after the second break. In session 24, the focus was still on the interpretive cues and not yet on the expressive goals those effects were designed to achieve.

The transition to focusing primarily on expressive cues took place at the beginning of the third learning period. The pianist did not provide another spontaneous description of the cues she was using like those we have described so far, but between sessions 31 and 32 she gave a more formal, written description for one section of the piece. This was prompted by the memory conference for which we had begun collecting the data nine months earlier. It was time to give a talk on "Memorizing for piano performance" (Chaffin & Imreh, 1994). To provide a concrete example of the cues she was using, Gabriela drew the diagram reproduced in Figure 11.2, showing the cues for the *C* theme.

Figure 11.2 shows how the sections of the formal structure were labelled and the basic, interpretive, and expressive performance cues were indicated by arrows. Unlike the figure, only the expressive cues were labelled. This, together with the fact that expressive cues were explicitly mentioned here for the first time, suggests that it was the expressive cues that were now in the spotlight of attention.

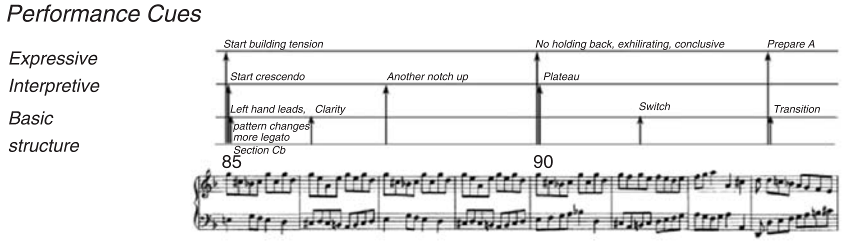

Figure 11.2 The performance cues (indicated by arrows) that the pianist reported attending to during practice for subsection *Cb* (bars 85–93) of the *Presto*. The number of cues per bar of each type served as predictors of practice, tempo, and recall. From Chaffin & Imreh (1997). Adapted with permission.

Figure 11.2 illustrates the relationship of the different types of cues. Bar 85 contains all four kinds: basic, interpretive, expressive, and structural. Each represents a different way of looking at the same point in the music. In session 12, Gabriela was worrying about transitions between sections and in bar 85 was thinking about starting section *Cb*. In session 17, she was focused on what her hands should be doing and thinking about the basic cue, "left hand leads". By session 24, the focus was on how the piece sounded, and attention was on the interpretive cue, "start *crescendo*". Finally, some time before the end of session 31, she was able to focus on the musical effects of all of this, and the expressive cue "start building tension" took centre stage. We can see in this one bar the progression that we have been tracking from the upper levels of the hierarchy in session 12 (structure), to the bottom level in session 17 (basic), back up one level in session 24 (interpretive), and up another level by session 31 to the expressive cues.

11.2.3 Effects of performance cues on starts and stops during practice

Another source of information about the pianist's focus of attention is provided by her practice. Where did she start and stop? Which bars were repeated more? Starting at a particular location requires attention to that location, as does stopping, at least when it is deliberate. Repetition, likewise, indicates that a passage was singled out for attention. Figure 11.3 shows a portion of the practice record for session 9 for the same short passage for which we described the performance cues, immediately above. Each time the pianist stopped a new line begins (Figure 11.3) on the next line up. The record shows that some bars were repeatedly used as starting places. What was special about these bars? Inspection of Figure 11.2 provides the answer.

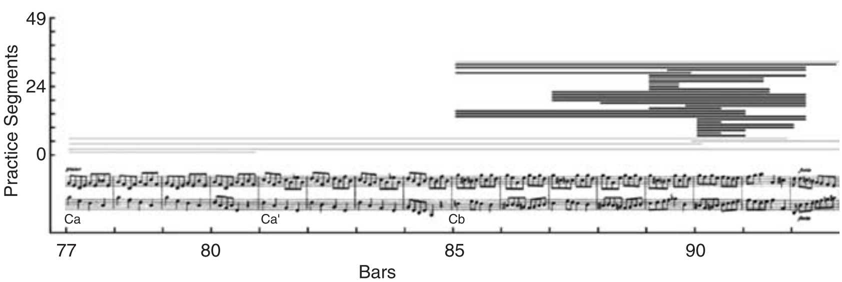

Figure 11.3 The record of practice of section *C* (bars 77–84) during session 9. The record reads from bottom to top, with each line representing the playing of the music shown below. Each time the pianist stopped and started again the record begins again on the next line up. The starting places correspond to the location of the performance cues for the passage. In session 9, the pianist was setting up the performance cues by using them as starting places. From Chaffin & Imreh (2001). Adapted with permission.

These bars contained performance cues and in Figure 11.2 we see these cues being set up (Chaffin *et al.*, 2003). Starting at those locations established them as performance cues so that later simply thinking of that spot was sufficient to initiate playing (Chaffin & Imreh, 2002). This conclusion is not based solely on the few bars in Figures 11.2 and 11.3. Detailed statistical analysis of practice of the rest of piece in this and other sessions confirmed that the same was true for the piece as a whole (Chaffin & Imreh, 2001, 2002; Chaffin *et al.*, 2002, Chapter 8; Chaffin *et al.*, 2003).

The practice in Figure 11.3 consists mainly of the repetition of short segments. We call this kind of practice *work*, and distinguish it from *runs* in which longer passages are played with minimal interruption (Chaffin & Imreh, 2001; Chaffin *et al.*, 2002, Chapter 6). We have used work to illustrate practice in Figure 11.2 because the small number of bars involved in work makes the figure easier to read. For the purpose of identifying performance cues, however, runs are more informative. Runs cover substantial portions of the piece and so require use of performance cues to retrieve the upcoming passage from long-term memory. Interruptions are likely to occur when a cue does not operate fast enough, so that playing stops at the cue and the bar has to be repeated. Deliberate starts and stops are also likely to occur at performance cues since they are the main landmarks. So, we will look at starts, stops, and repetitions during runs to see when each type of performance cue was receiving attention.

Table 11.2 shows the sessions in which runs were affected by each type of performance cue. The table summarizes the results of statistical analyses that

Table 11.2 Summary of changes across sessions in the effects on practice of the formal structure and of basic, expressive and interpretive performance cues

	Type of performance cue			
Session	*Structure**	*Basic*	*Interpretive*	*Expressive*
7–8	+	+	+	+
9–10	+	+	+	+
11–12	+	+	+	•
17	+	+	•	•
20–24	+	•	+	+
28–30	+	**(+)**	•	+
31–44†	+	•	+	•

* Effects of structure include effects of section boundaries, serial position of a bar in the section, and switches (places where two identical variations of a theme first diverge).

+ Significant effects ($p < .05$) in regression analyses with starts, stops, and repetitions as dependent variables and performance cues and structure as predictor variables.

• Non-significant effects in regression analysis.

(+) This effect was negative and may reflect avoidance rather than practice of performance cues. With one other exception the remaining effects were positive.

† Development of expressive cues was completed by session 31; sessions 31–44 were devoted to increasing the tempo.

identified when starts, stops and repetitions during practice tended to cluster at performance cues of each type (see Chaffin *et al.*, 2002, Chapter 8 for details). A "+" in the table indicates the sessions in which this happened for each type of performance cue.[2] The effects of performance cues on practice showed the same ordering – from basic to interpretive to expressive – that we have already seen in the self-reports (there were also interesting differences, which we discuss below). Practice of performance cues began in sessions 7–8, when the pianist began to play through the entire piece rather than practising section by section. This was the first time that performance cues were needed to recall the music from memory as the piece unfolded and all four kinds of cue were practised, both in sessions 7–8 and again in 9–10. The framework for performance was being set up. Structural cues then continued to affect practice throughout the entire learning process, while for the other three kinds of cue there was an interesting progression of effects.

The progression is consistent with the idea of a hierarchical ordering of cues from basic to interpretive to expressive. After initially encompassing all four kinds of cues in sessions 7–8 and 9–10, the pianist's attention first narrowed. The effect of expressive cues disappeared in sessions 11–12, then the effect of interpretive cues disappeared in session 17, leaving basic cues as the focus. The progression in the first half of the learning process was thus: expressive, interpretive, basic. Session 17, in which performance from memory was finally mastered, marked the turning point.

After session 17, attention moved back up the hierarchy one level at a time – basic, interpretive, expressive – the effects of each type of cue disappearing in turn as it was mastered. (Effects of structural cues were present throughout.) Effects of basic cues, which were present in session 17, disappeared in sessions 20–24. Next, the effect of interpretive cues, which had been present in sessions 20–24, disappeared in sessions 28–30. (The effect of basic cues in sessions 28–30 was negative and probably indicates that the pianist was ignoring these trouble spots while she focused on the expressive cues.) Finally, the effect of expressive cues, which had been present in session 28–30, disappeared in sessions 31–44. The progression was: basic; interpretive; expressive.

The ordering of effects is consistent with the idea that the three types of performance cue were hierarchically ordered, with lower level basic cues being practised and mastered first and expressive cues last. The progression was down the hierarchy before session 17 and back up again afterwards. The spotlight of attention began at its widest and then narrowed, withdrawing first from expressive and then from interpretive cues, leaving only basic cues as a focus of both self-report and practice in session 17. Then the spotlight moved back up the hierarchy as first basic, then interpretive, and finally expressive cues were mastered.

Sessions 31–44 represent an inconsistency in this orderly picture. The learning process did not end neatly with the practice of expressive cues in sessions 28–30. The practice of interpretive cues in sessions 31–44 suggests that, contrary to our account, the learning process concluded with attention to

interpretation rather than expression. We do not believe that this was the case. As noted above, the piece was essentially ready for performance by session 31 except that the pianist decided on a faster tempo. Sessions 31–44 were spent bringing the performance up to the new tempo and the effect of the interpretive cues in these sessions tells us that the new tempo was achieved mainly by adjusting the interpretive cues, probably by reducing their number. The effect of these cues in these sessions does, however, muddy the waters. The next two sections provide further evidence to support our claim that during the final performance the spotlight of attention was on the expressive cues. First, however, we need to discuss the relationship between the self-report and practice data.

For the four occasions (described in the previous section) when the pianist described what she was attending to while playing, the self-reports and practice were in agreement. The cues that Gabriela described, she also practised. But practice was also affected by other kinds of cues not mentioned in the self-reports. In session 12, when the comments indicated that the pianist was having trouble keeping the different sections straight, practice was affected by structure, but also by basic and interpretive cues. In session 17, when the pianist's self-report was all about basic cues, basic cues were practised but so were structural cues. In session 24, when interpretation became the focus of the self-report, interpretive cues were practised, but so were expressive cues. In sessions 28–30, just before the expressive cues were first mentioned between sessions 31 and 32, expressive cues were practised, but so were basic cues. The reason for these differences between self-reports and practice is that the two types of data give somewhat different pictures of what was happening. The self-reports tell us what the pianist was focusing her main problem-solving efforts on. Practice reflects the same influences, but was also influenced by other aspects of the music whose effects were more automatic and whose influence on practice occurred without the spotlight of attention (Chaffin & Imreh, 2001; Chaffin *et al.*, 2003).

In spite of their differences, practice and self-reports both point to the same progression from basic, to interpretive, to expressive cues. As noted above, however, the practice of interpretive cues in sessions 31–44 casts some doubt on this conclusion and so we turn now to the final performance, recorded on CD, for more direct evidence of what the pianist was attending to as she played.

11.2.4 The effects of performance cues on the polished performance

Effects of structural and expressive cues were evident in the final performance of the *Presto* recorded on the CD (Chaffin & Imreh, 2002; Chaffin *et al.*, 2002, Chapter 9). The tempo was regular, appropriate to the performance conventions of the Baroque period and the character of the *Presto*. There were, however, small variations, which were detectable in measurements of inter-bar intervals made from the audio signal (Chaffin & Imreh, 2002; Chaffin

et al., 2002, pp. 228–233; Chaffin, Lemieux, & Chen, 2006). The tempo of each bar was systematically related to the formal structure and to the location of expressive cues. The differences were very slight and, if they are detectable to the ear, it is only as subtle changes of emphasis, not as changes in tempo. But the differences occurred consistently enough throughout the piece to register as statistically significant in analyses similar to those described in the previous section for practice. The results for the CD performance are summarized in the first row of Table 11.3.[3] The formal structure was marked by a slowing of tempo from beginning to end of sections while expressive cues were marked by faster tempos. The effects draw the listener's attention to the boundaries between sections and expressive phrases (Clarke, 1988, 1995; Shaffer, 1984) and their presence suggests that the pianist was also attending to these places as she played (Sloboda & Lehmann, 2001).

The presence of effects of structural and expressive cues on the CD performance does not, however, prove that the pianist was attending to these cues as she performed. The effects might have been produced automatically, the product of highly trained motor responses. The effect of expressive cues was, however, *not* present in trial performances in sessions 49 and 50, just a week before the CD performance. And these were *performances*, not simply practice; the pianist was trying to capture a perfect performance on videotape to use in talks about the research. For most purposes, the performances in these sessions and on the CD were identical, but our measurements were able to detect two subtle differences in the effects of performance cues. First, expressive cues, which were marked by faster tempos in the CD performance, were distinguished by slower tempos in two performances in session 49. It seems that the heightened arousal of the recording session may have resulted in a more expressive performance. Second, bars containing basic cues were slightly longer than other bars in three performances in session 49 but not in

Table 11.3 Summary of effects of performance cues on tempo during the CD performance and on performances in sessions 49 and 50

		Type of performance cue		
Performance	*Structure**	*Basic*	*Interpretive*	*Expressive*
CD	+	•	•	–
49.2	+	+	•	•
49.3	+	+	•	•
49.4	•	•	•	+
49.5	+	+	•	+
50.2	+	•	•	•
50.3	+	•	•	•

* Effects of structure include effects of section boundaries, serial position in a section, or both.
+/– Significant effects ($p < .05$). Positive effects indicate slower, negative effects faster tempos. Positive effects of serial position were due to tempo decreasing from beginning to end of a section.
• Non-significant effects in regression analysis.

the other performances. The effect probably reflects the pianist's desire for a note-perfect performance. Taking a little more time on basic cues ensured accuracy. The degree of caution or risk-taking is something that must be decided each time (Kenny & Gellrich, 2002) and is one source of the spontaneous decision-making that makes performance a creative activity.

In summary, the fact that basic and expressive cues had different effects in these performances indicates that the performances differed subtly at musically important locations and suggests that these differences were the product of how attention was directed to the various performance cues.

11.2.5 Effects of performance cues on memory for the score after two years

One final piece of evidence that performance cues provided the main landmarks for the final performance comes from the pianist's memory for the piece more than two years later. She had not played the *Presto* in the meantime, so her memory provided a window into the way the piece had been organized in her mind the last time she had played it – in the recording studio two years earlier. Recall of an ordered series is generally better for the first item and declines with each succeeding item (Broadbent, Cooper, & Broadbent, 1978; Roediger & Crowder, 1976). This kind of *serial position effect* is indicative of a memory organization in which a retrieval cue activates the first item in an associative chain; then recall of each successive item is cued by the previous item in the chain (Rundus, 1971). If the pianist's memory of the *Presto* were organized into chunks on the basis of the formal structure, then we would expect to find a serial position effect for sections, with recall being best for the first bar of each section and declining with each successive bar. Likewise, if her memory were organized by expressive goals, we would expect recall to be best for bars containing expressive cues and to decline with each successive bar after these cues. Serial position effects for interpretive or basic cues would similarly indicate that memory for the piece was organized into chunks that were accessed at these cues.

So, 27 months after the recording session, the first author, without warning, asked the pianist to play the *Presto* from memory. She indignantly refused. Then, relenting, she agreed to write out part of the score from memory. Her memory was remarkably good, 65 per cent accurate (Chaffin & Imreh, 1997; Chaffin *et al.*, 2002, p. 212). More interesting, though, were the effects of the different kinds of performance cue on memory.

Table 11.4 shows the effect of serial position with respect to each type of performance cue on recall of the score (Chaffin & Imreh, 2002; Chaffin *et al.*, 2002, p. 214). The top row of the table shows that distance from the start of a section had the expected effect. Recall for the first bar of each section was nearly perfect; it declined progressively with distance from the beginning of the section. This pattern of results tells us that the pianist's memory was organized, as expected, in terms of the sections of the formal structure with

Table 11.4 Probability of correctly recalling the score decreased with distance from section boundaries and expressive cues and increased with distance from basic cues

Type of performance cue	*Serial position: Distance from cue (number of bars)*				
	1	2	3	4	5–8
Structural boundary	.97	.90	.87	.69	.28
Expressive	.85	.85	.74	.43	.00
Basic	.68	.77	.78	.77	.46
Interpretive	.75	.78	.61	.00	no value

the start of each section providing a landmark (retrieval cue) at which memory for the piece could be accessed and with memory for each succeeding bar being triggered by the bar before it. Expressive performance cues showed a similar serial position effect. Recall was highest for bars containing expressive cues and for the bar immediately following and then declined sharply over the next two bars. This tells us that the pianist was right when she said that she had retrained herself in the latter stages of the learning process so that expressive cues came to be the main focus of her attention.

Interpretive and basic cues did not show the same effect. The interpretive cues did show a small decline with serial position but the effect was not statistically reliable. For basic cues, the effect of serial position was in the opposite direction. Bars containing basic cues were remembered *worse* than other bars. This tells us that role of basic cues was different. Basic performance cues ensure the execution of critical details, such as the placement of a particular finger. Attention to details of this sort leaves fewer attentional resources for other features, resulting in poorer recall. Attention to expressive and structural cues, on the other hand, elicits memory for the entire passage that follows. Rather than coming at the expense of other features, these cues encapsulate or chunk a passage. Thinking of a section or expressive phrase activates its more detailed representation in memory, while thinking of a basic cue activates just the memory for that particular detail.

Thus, recall of the score provided a window into how the pianist's memory was organized at the time of the final performance. Musical structure and expression provided the main landmarks, while basic cues represented specific obstacles that might require attention. The conclusion is consistent with our suggestion that at end of 10 months' practice the pianist's main focus of attention during performance was on the expressive cues.

11.3 Conclusion

Solo recitals in the Western classical music tradition place extraordinary demands on the performer. Performances must be practised to the point that

they can be delivered automatically in order to ensure reliability under the pressures of the concert stage. At the same time, the performance must remain fresh and flexible enough to permit recovery from inevitable mistakes. We suggest that the integration of automatic motor performance and cognitive control needed to provide this flexibility is achieved through the practice of performance cues. Use of performance cues is an attentional strategy that maintains conscious control of a highly automated performance. It is in the ability to control, and thus to modify, a highly prepared performance that the creativity of musical performance lies.

When a performer has to think mostly of basic cues dealing with matters of technique, the possibilities for creativity are limited. When a performer is focused on interpretive cues and is thinking about what the music sounds like, the opportunities for creativity are greater but still limited. The goal of performance is to evoke musical feelings and this is best achieved when the performer focuses on expression. A creative performance is, therefore, most likely when the performer is focusing on expressive cues. This allows the artist to adjust the performance to the unique opportunities and demands of the occasion to achieve the maximum possible impact on the audience.

We have illustrated this account of how a performance is prepared with a case study of a pianist learning the *Presto*. Our analysis was based initially on the performer's report of her own experience. We then looked for behavioural evidence to test that account. The pianist's spontaneous descriptions of what she was attending to during practice indicate that during her first practice performance without the score in session 12 she was focused on structure, that the next time she played from memory, in session 17, she was thinking mostly about basic cues, and that by session 24, when she was ready for her first public performance, she was attending mostly to interpretive cues. Only when preparation was almost complete, between sessions 31 and 32, were expressive cues mentioned explicitly for the first time. The practice data showed a similar progression, with practice focusing initially on all of the different levels of cues and then progressively on basic, interpretive, and finally expressive cues, with musical structure influencing practice throughout. Both self-report and practice showed that the pianist was training herself to attend to performance cues and focused attention successively on structural, basic, interpretive, and expressive cues.

The fact that the pianist paid more attention to expressive cues in sessions 28–30 is suggestive, but does not prove that these cues were the main focus of attention during the final performance. This conclusion is, however, supported by two additional sources of evidence. First, expressive and structural cues affected the tempo of the CD performance even though the expressive cues did not affect practice performances recorded a week earlier, suggesting that the pianist was attending more to expressive cues during the CD performance. Second, expressive and structural cues provided the main landmarks of the pianist's memory for the piece two years later, again suggesting that these cues had also served as landmarks when she last played the *Presto*

two years earlier. The behavioural evidence thus supports the pianist's report that she trained herself to attend primarily to expressive cues during performance. Attending to these cues provides the means to creatively adjust a performance to make the most of the expressive possibilities of the occasion.

The presence of differences between practice performances of the *Presto* at musically significant locations suggests that this kind of variation is probably characteristic of most performance. Tempo variation in the *Presto* is not a promising place to look for musical spontaneity or creativity and finding it suggests that such differences are a normal part of musical performance. With a live audience or with music that called for greater expressive variation in tempo, greater variation between performances would be expected.

Musical performance is a creative activity because a soloist must adapt a highly prepared interpretation to the differing circumstances of each performance. We have shown that a highly prepared performance varied from one occasion to another and that, at least for the highly skilled professional we studied, some of the variation was related to the performance cues that she was attending to as she performed. The differences thus reflect a kind of musical spontaneity and suggest that the creative process of developing the interpretation was continuing, albeit in small ways, in successive performances. Although performances in the Western classical tradition are highly practised and polished, performance can and should be a creative activity.

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Notes

1 The description of the weeks during which each stage of practice occurred has been simplified in the table by ignoring one or two isolated sessions that occurred during each break (see Chaffin *et al.*, 2002, p. 99 for details).
2 For the analyses, adjacent sessions were grouped together into 11 session sets. Four session sets were omitted from the table to simplify description. Sessions 1–6 were omitted because they were devoted to practice of technique; performance cues were not practised (see Chaffin *et al.*, 2002, p. 188). Sessions 13, 14–16, and 25–27 were omitted because they occurred after the two long breaks and were mainly devoted to relearning. The sessions that are included give a picture of how the practice of performance cues developed continuously across the learning process.
3 The results summarized here for the CD performance differ slightly from those reported previously for the same performance (Chaffin & Imreh, 2002; Chaffin

et al., 2002, Chapter 9), in being more accurate (mean error of measurement = 8 ms; 90% of errors < 16 ms). The most important difference is that the effect of expressive cues became statistically significant for the CD performance, while with the previous measurements it was not.

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Part V

Creativity in music therapy

12 Musical creativity in children with cognitive and social impairment

Tony Wigram

12.1 Introduction

The development of music therapy over the second half of the twentieth century to its current professional status has been motivated by the concept that the art form of music is an effective therapeutic medium because of its potential for conveying creativity, expressivity, and communicativeness to humankind. There are a number of different schools of music therapy. Historically, the two main approaches have conceived of music either as a *behavioural* tool (offering contingent reinforcement and programmed learning for clients who come for therapy) or as a *psychotherapeutic* tool (for exploring the emotional needs of an individual in their unconscious world, and providing a therapeutic intervention for them). The latter approach has been the predominant focus in the development of music therapy in Europe, where methods of application have relied on improvisational techniques.

12.2 Creativity in the theory of improvisational music therapy

The concept of *creativity* is so central within the European model that it has become a much used – if not overused – concept to explain the therapeutic value of music therapy for clients. Free Improvisation Therapy (FIT) (Alvin, 1975; Bruscia, 1987) consists of "any or all attempts to create sounds or music that were not composed or written beforehand, ranging from merely sounding an instrument in different ways, or producing disorganized vocal sounds, to inventing musical themes and creating musical forms" (Bruscia, 1987, p. 77). Another model of music therapy, Creative Music Therapy (originally called Nordoff–Robbins Music Therapy) includes creativity both in its title and in its definition of creative processes involved in the therapy. It is described as "creative" because "it involves the therapist in three inter-related levels of creative work" (Robbins, 1984). As Bruscia (1987, p. 24) explains:

> First, the therapist creates and improvises the music which will be used as therapy. Second, the therapist uses the improvised music creatively within each session – to seek out, gain, and maintain contact with the client

> from moment to moment – to "create" the therapeutic experience. Third, the therapist also creates a progression of therapeutic experiences from session to session, supporting stages in the client's creative development. Thus, the therapist creates: the musical resources to be used within each therapeutic experience, the therapeutic experiences and techniques to be used and the processes whereby these experiences and techniques are sequenced.

Alvin, Nordoff and Robbins all worked with children with cognitive and social impairment. Analytical Music Therapy (AMT) (Priestley, 1994) also involves a creative process in music making in order to draw out unconscious experiences and feelings from clients in therapy, and treat them through an analytical model of work.

12.2.1 Defining and appraising improvisation

Because improvisation is the principal medium for music therapy, and because improvisation is a process that draws on the potential creativity of the improvisational skills of both client and therapist, it is necessary for the purpose of this chapter to define what is meant by improvisation as it is used within music therapy. It is also important to explain that there are many different forms of improvisation, from the quite free, unstructured, and atonal models frequently used in the field of psychiatry and in working with people who are going to therapy for personal development, to much more structured or directed forms of improvisation for clients who have a wide range of pathologies. An attempt was made some 20 years ago to establish a broad-based definition for "improvisation" in music therapy. First, musical improvisation was described as "Any combination of sounds and silence spontaneously created within a framework of beginning and ending" (Association of Professional Music Therapists (APMT), 1985).

This allowed all sorts of noises to be included and defined as musical improvisation, and strongly underpinned the philosophy of one of the founding pioneers of music therapy in England, Juliette Alvin, who argued that since Stravinsky, dissonant and atonal sounds became the "new music" with the consequence of allowing those sounds in free improvisation. Adapting this definition to the creative use of music for therapy required that any production of sound could be interpreted as musical and improvisational, providing the context was clearly therapeutic. The definition of clinical improvisation followed as: "Musical improvisation with a specific therapeutic meaning and purpose in an environment facilitating response and interaction". Clinical improvisation has subsequently been redefined as: "The use of musical improvisation in an environment of trust and support established to meet the needs of clients" (APMT, 1985).

The creative process in music therapy does, it should be emphasized, rely on the skill of an improviser who creates potentials and possibilities within

which the client becomes able to play music and feel a sense of process and exploration in what they are doing. If creative music making is a medium for a therapy process this, by implication, assumes that as the client goes through their therapeutic process at some stage they will begin to develop their own skills and potentials, using music in a creative way. It is most noticeable where this does not happen, as in the case of clients who are too defended, too rigid or too pathologically impaired to expand and develop a creative skill in the use of musical material. Whether the client has innate musical aptitude or developed musical skills does not prevent pathologies such as autism, depression, or obsessive compulsive disorder from blocking creative music making. As a general principle, music therapists employ free improvisation because it does not require any level of previous musical skill or competence in the clients and allows the music making to be truly an expression of the client's personality and feelings. Both musical and therapeutic skill are required of the therapist to help clients with entrenched and chronic behaviour to develop or change, even though there will always be a limit to the degree and permanence of that change. Applied therapeutic methods such as "dialoguing" (a process where therapist and client(s) communicate through their musical play; Wigram, 2004) and *frameworking* (defined below) are effective in disturbing and breaking through rigid patterns of musical behaviour.

An important and interesting perspective on the art of improvisation, with particular focus on some of the processes involved in teaching this difficult subject, was described by Schwartz (1998). He explored both sides of the process: the learning of improvisation by a student, and the teaching of improvisation by an educator. Learning to improvise can be one of the most challenging tasks for any musician, even though one might have thought it to be a creative and exciting experience. This is mainly because one is spontaneously creating music which is one's own music, and this impromptu composition can attract the same subjective and objective criticism that any composition attracts: "Too repetitive, too loud, too dull, not a good structure, no nice melodies, poor harmonic modulations, limited, confusing, no direction etc., etc.". Anybody who sits down to improvise, as a performance for others, is creating music that is essentially drawn from their own technical and musical resources, as well as their creative impulses. The "others" are always there. Alvin once said that "music is a creation of man – and that is why we can see man in his music" (Alvin, 1982).

12.3 Creative improvisation as a clinical tool

This chapter considers the potential creativity in music making by children who have a pervasive developmental disorder that includes both cognitive and social impairments, in particular by children with autistic spectrum disorder and Asperger's syndrome. Music therapy has traditionally been recommended as an effective treatment for this population on the grounds

that severe limitations in the development of verbal language and conventional forms of non-verbal communication such as eye-contact, gesture, and body language have significantly limited the development of communicative skills in these children. Verbal language is typically impaired in the autistic population, as well as in children with other types of pervasive developmental disorders, in both expressive and receptive forms. Music is a medium that involves a complex range of expressive qualities, dynamic form and dialogue, and clearly offers a means by which some form of alternative communication can be established to help children with these impairments achieve engagement, interaction and relationships. In fact, timing in mother–infant babble and pre-verbal engagement has been argued by Trevarthen (1999) to be the foundation of human communication.

Children with pervasive developmental disorder demonstrate some of the same pathological problems in music making as they do in their everyday life and play. In particular, one sees evidence of stereotypes and rigidity in musical play. For example, the typical non-functional use of toys is also found in the way an autistic child behaves with musical equipment: spinning and twiddling jingles on a tambourine; fiddling with the butterfly nut of a cymbal and spinning the cymbal; bunching and watching the swaying pattern of a set of bars suspended on a wooden frame (windchimes); stroking and fiddling with metallic instruments such as Indian cymbals or gongs; and even playing with parts of the piano such as the folding music holder or the lid are typical examples of this type of play (Wigram, 1999). "Music making" of this kind should not be construed as musically intentional, and unless some element of creative musical process can be evoked in the development of the music making, one will typically see the child lost in rather repetitive and rigid patterns of movement, just as one sees in other aspects of their aimless activity. Music therapy assessment can therefore identify limitations and weaknesses in clients, which they may find hard to recognize and accept. But it is perhaps important to mention here that any perception by the lay population, and even fellow disciplines, that music therapy is a process designed to give "joy and happiness to all" is certainly misconceived. Working through difficult problems and gaining insight are often the central tasks of a music therapy intervention.

Nevertheless, it may be argued that the presentation or introduction of some formal structure in the music is more likely to attract and draw a child with such obsessive behaviour patterns into musical activity that is creative. Simply allowing free improvisation may result in the therapist matching and copying the child's stereotypical patterns of behaviour.

12.3.1 Examples from the literature

De Backer (2001) analyses the important process of transfer from sensory motoric playing to the creation of musical form. In work with psychotic clients, De Backer describes a repetitive, motoric style of playing that,

without variability in tempo, dynamic form, or direction, is characterized as a rigid, unchanging, and uncreative style of making music where the pathology is evident in the musical production. Given the manipulation or provocation of musical parameters such as tempo, accents, and rhythmic patterns, De Backer finds that musical form emerges, and that the structures and patterns inherent in musical form promote a conscious awareness in the client, first of their music making, and second of themselves.

Darnley-Smith & Patey (2003) refer to the creative process during improvisation. They describe how improvisation can occur when a musician finds a new way of phrasing a melody or emphasizing some type of rhythm even when they have played the piece many times before. They also refer to the interesting process that occurs when improvised jazz develops through accidents in the music. For example, they refer to a jazz improvisation by the pianist Keith Jarrett where the genre of the music allows the mistake not only to be woven into the music but also to be used as a spontaneously new idea. Ansdell (1995, p. 24) refers to an example of this nature from a jazz improvisation by Keith Jarrett, as follows:

> Jarrett set up a repetitive ostinato pattern with his left hand but then seemed to miss the "right note" (according to the pattern). However, he has such musical flexibility that he instantly uses the "mistake" to create something new – starting the next repetition of the figure on the "wrong" note and "correcting" it upwards. This does not sound like a mechanical correction but an inspired detail which then changes the course of the music.

When clients play, and make sounds that do not sound "quite right", this can cause self-conscious responses, perhaps even a feeling that the medium of music may be difficult for them, which can result in negative responses to music therapy as well as possibly reinforcing feelings of inadequacy and failure. A skilled music therapist can, in the same way as Jarrett in the above example, convert an apparently wrong or incorrect sound into a part of the improvisation simply by repeating it and then incorporating it as a feature of the musical tapestry.

12.3.2 Children with autistic spectrum disorder (ASD): Rigidity and creativity

Research studies and clinical reports have shown that music made spontaneously and creatively through structured and flexible improvisation attracts the attention and provokes engagement in children with pervasive developmental disorder, and promotes the development of reciprocal, interactive contact and play (Edgerton, 1994; Oldfield, 2001; Wigram, 1999, 2001). Evaluation of musical interaction in music therapy reveals that the presence of structure in music, including 16 and 32 bar frames with stable

elements of tempo and meter that still allow flexibility and freedom, promotes creative music making in children with ASD or other social impairments. The development of musical creativity involves a subtle process of learning patterns within musical structures and frames that then spontaneously develop variability in dynamic, tempo, duration, and accentuation. For children with significant impairments in their basic innate skills in communication, this musical interaction can provide a frame for development. This population also demonstrates a lack of sharing and turn-taking in play, repetitive, rigid and somewhat unchanging patterns, and a need for sameness.

Formal standardized assessment tests in cognitive psychology highlight strengths and weaknesses, and measure IQ, but they are procedural, and do not have any degree of flexibility to explore a child's creative potential, particularly when a pathology such as ASD limits this area of development. Music making is potentially a richer medium for promoting creativity and, as a form of assessment, it offers significant strengths for assessing the areas of social engagement and non-verbal communication: precisely the areas in which children with autism and Asperger's syndrome have some of their most profound difficulties. Music therapy, moreover, can evaluate more than just social engagement because it looks quite specifically at musical events and musical behaviour, and makes detailed evaluations and interpretations of both quantitative and qualitative data on a client's activity. The frequency and duration of musical events that take place when therapist and client are playing can be counted in a quantitative analysis. Musical material, such as tempo changes, rigid or flexible rhythmic patterns, phrasing, changes in intensity, and general variability in style, can be analysed and measured.

12.4 Frameworks: A structure for creativity

The creation of an appropriate musical structure to enable a client to engage, or in response to a client's music, is a natural and helpful process during improvising, whether it is intentional or unintentional. The same approach is very relevant in music therapy practice where clients need, for one reason or another, a clear musical frame. This method is described as *frameworking*, and it is a specific tool in music therapy practice that can be used quite precisely in treatment (Wigram, 2004). A framework might have the function of inspiring and encouraging, or it might function to stabilize and contain. The relevance of this method for drawing out and promoting the musical creativity in children with ASD is that this population differs little from the rest of the population in needing some context in which they can develop creative ability. I define frameworking as follows (Wigram, 2004):

> Providing a clear musical framework for the improvised material of a client, or group of clients, in order to create or develop a specific type of musical structure.

A musical structure is created to allow (and inspire) the development of more expressive and creative playing by the client. In his 64 improvisation techniques, Bruscia (1987) offers the term *experimenting* and explains that it involves "providing a structure or idea to guide the client's improvising, and having the client explore the possibilities therein" (Bruscia, 1987, p. 535). This is a more general definition, not specifically confining the method to a musical framework.

Frameworking can be either a directive or a structuring technique in music therapy. It is not primarily empathic in its purpose, although the emotional quality of the frame provided can be sympathetic to the feelings and mood of the client. Provided that it doesn't become over-dominant, it may be a marvellous technique for encouraging and exploring the musical and communicative expressivity of the client. As with extemporization, it is used for specific purposes with specific clients, and there are examples where providing a musical framework has helped a client "move on" (change and grow), or to develop expressivity in the way they make music or join in.

12.4.1 Structure and flexibility: The potential of jazz improvisation

Elements and degrees of structure play an important role in therapeutic improvisation when used to give a musical framework within which the client is able to improvise or play. Tonal frames, as in jazz improvisation, provide a more secure and predictable musical sequence. A frame can typically be used when a client is playing on drums, or other percussion instruments, but can also be applied successfully if a client is playing diatonically on the piano, xylophone, marimba, or metallophone, or singing. But the therapist needs to be prepared for a client's lack of fluency, sometimes working flexibly with pauses in the client's music. Significant skills are needed to be flexible with tempo and with meter, so that when a client "falls out" of the structure (missing a beat, or varying tempo) a creative adaptation can be made.

This framework is often provided through the style of playing. The clinical case described below demonstrates the potential of an 8/16 bar jazz harmonic frame in eliciting creativity in structured improvisation. Improvisational techniques also used in developing structured improvisation are *tonal grounds, harmonic grounds, rhythmic grounds, walking basses* and *melody dialogues*. There are three distinct forms of musical and therapeutic transition: *overlap transitions, limbo transitions* and *seductive transitions* (Wigram, 2004). These enhance the creative potential by moving an improvisation from one frame with certain musical characteristics to another. For example, if a child is playing softly, without pulse, *legato*, and atonally, a transition can develop their musical production into *staccato*, accented, pulsed, and more tonal, melodic dialogues. Both harmonic grounds and the development of rhythmic grounds help this process, with a walking bass providing the rhythmic ground.

With clients who have autism and ASD, their primary need is for a stable

structure with which they can feel secure, and within which they can demonstrate their potential communicativeness and creativity. Jazz frameworks can provide security, and at the same time allow creative improvisation within the structure. An important guideline in both tonal and atonal improvisation is to include repetition of ideas, sequences, and repeated phrases to ensure that there is some direction and familiarity in the musical material. As Schögler (1998, 2003) has demonstrated, the "communicative musicality" of an improvised jazz duet has a "narrative" structure based on a shared pulse similar to that of spontaneous interplay of expressions in a mother–infant dyad.

12.5 Analysis and interpretation of musical material: Descriptors for creativity

Some models and tools have been developed for the analysis and interpretation of musical material in creative improvisation – none of them standardized. Evaluation or assessment scales developed to date have focused on a variety of aspects of the music therapy process, including, to name but a few: musical interaction (Pavlicevic, 1995); response, relationship, and musical communicativeness (Nordoff & Robbins, 1977); diagnosis (Raijmaekers, 1993; Wigram, 2000); psychological function (Sikström & Skille, 1995); cognitive, perceptual, motor, and visual skills (Grant, 1995); sound-musical profiles (Di Franco, 1999); elements that contribute to the structure of music (Erdonmez Grocke, 1999); the predictability of music (Wigram, 2002b); and the analysis of improvised music (Bruscia, 1987). Analysing improvisations in order to identify, compare, interpret, and reach conclusions about a client's personality, pathology, and presentation is a critically important aspect of music therapy. Improvised music provides a rich source of data and, when analysed comprehensively, contains highly relevant information that has been obtained through a spontaneous and creative process.

One assessment procedure that focuses specifically on musical elements as the basis for analysing change or lack of change in clients is the *Improvisation Assessment Profile* (IAP) (Bruscia, 1987). Despite the fact that IAPs have been in the literature for some years, there is currently a limited use of this comprehensive assessment tool. It is a complex, detailed, and extensive method of analysis that can be off-putting to the practitioner with limited time for analysing the music. When IAPs are used in their most comprehensive way, analysis of a short excerpt from a music therapy session can take several hours.

In the complete set of profiles, Bruscia has defined six specific profiles as areas of investigation: autonomy; variability; integration; salience; tension; and congruence. Each profile provides specific criteria for analysing improvisation, and the criteria for all the profiles form a "continuum of five gradients or levels, ranging from one extreme or polarity to its opposite" (Bruscia, 1987, p. 406). The two profiles that are particularly relevant for the analysis of

musical material with children who have ASD are the *autonomy profile* and the *variability profile* (Bruscia, 1987, pp. 404–405).

> The autonomy profile deals with the kinds of role relationships formed between the improvisers. The scales within the profile describe the extent to which each musical element and component is used to lead or follow the other.
>
> The variability profile deals with how sequential aspects of the music are organised and related. Scales within the profile describe the extent to which each musical element or component stays the same or changes.

These two profiles are useful in differentiating between children who have autism and those with some other variant of pervasive development disorder or communication disorder. The gradients on the autonomy profile (dependent; follower; partner; leader; resistor) can be applied to musical parameters (rhythmic ground; rhythmic figure; tonal ground; melody; harmony; texture; volume; timbre; and lyrics) to look closely at the interpersonal behaviour, including "taking turns", "sharing and acting as a partner", or the child's propensity for either "resisting suggestions" (independent) or "becoming extremely dependent" (dependent). The gradients on the variability profile (rigid; stable; variable; contrasting; random) can be applied to musical parameters (tempo; meter; rhythmic figure; melodic figure; tonal ground; harmony; style; texture: overall; texture: roles; texture: register; texture: configurations; phrasing; volume; timbre; body; and lyrics) to illustrate at an intermusical and intramusical level the child's capacity for creativity, or to bring out evidence of a child's rigid or repetitive way of playing that might support a diagnosis on the autistic continuum (Bruscia, 1987, pp. 407–408; Wigram, 2000, 2002a).

The case example that follows initially demonstrates an analysis of musical structure, and then an analysis using the IAPs. As the theme in this chapter concerns creativity, the variability profile of the IAPs is appropriately defined to identify some degree of creativity (variability) in the playing style of the child. Three short improvisations from the assessment session were chosen to illustrate how this model of musical analysis can be used quantitatively to note and record events, as well as how the analysis can describe the creative playing of Joel when he was given a musical structure, and to bring out the therapeutic implications of the findings from the assessment.

12.6 Case example

Joel was referred for assessment at the age of seven, and was described as having the following problems:

- no use of non-verbal behaviour to regulate social interaction;
- does not use direct eye-contact;

- bad at relating to other people, and other children;
- does not share enjoyment;
- lacks socially imitative play;
- shows stereotypical, ritualistic behaviour.

An assessment of cognitive ability found him to have an intelligence quotient equivalent of 79, which indicates that his overall intellectual ability is within the normal range, although poorly developed. Joel was reported to be responsive to music, and his family said that he enjoyed "jazzy music".

A music therapy assessment session was undertaken with Joel primarily for the purpose of identifying characteristics of his behaviour in music that would support the diagnostic hypothesis. It was also intended to explore Joel's strengths and abilities, given the wealth of documentation on his problems and difficulties. This has been reported previously from the point of view of the relevance of music therapy as an assessment tool in multidisciplinary assessment (Wigram, 2002a), and the findings related specifically to determining the expectations of therapy from potentials demonstrated in music therapy assessment. During this session, Joel demonstrated a number of potential skills and abilities. He could share an activity, take turns, initiate, use verbal language spontaneously, concentrate for long periods, and share emotions (emotional synchronicity). He could also follow musical cues, structure, engage in imaginative play, and anticipate the way the therapist was thinking and reacting musically and non-musically. While Joel still meets criteria for a diagnosis of ASD, this level of social interaction does demonstrate the presence of musical response, aptitude, and creative skill that provides a platform for a level of engagement with the child normally denied by the strength of his pathology.

12.6.1 Musical analysis

The musical analyses presented in Tables 12.1, 12.2, and 12.3 were undertaken in order to illustrate the harmonic (jazz) frame that the therapist introduced in the two improvisations on the piano, and the rhythmic harmonic pattern that developed in the third improvisation when the client was playing drums and cymbal. Joel's playing is described in each table alongside the details of the musical frame provided by the therapist. The harmony of the chords is written as in guitar music, giving the key, the presence of added sixths, sevenths or ninths in the chord, and whether it is major or minor. The therapist and client are playing on separate pianos, with Joel on a grand piano and the therapist on an upright piano. Table 12.1 shows an analysis of the first session.

During this first improvisation, Joel demonstrates a good ability for creating a melody that matches the accompaniment frame provided by the therapist. He also demonstrates an ability to introduce his own musical ideas (melodic line, alternate hands, changes in tempo), and adapt to the harmonic structure of the therapist's chordal accompaniment.

Table 12.1 The first improvisation on two pianos using harmonic frames

Joel (client)	*Therapist*
Random bass notes, no pulse, no melodic direction Repeated note (high D) while watching hammers inside the piano – continues	Random (matching) melody, high register Downward, triplet, melodic phrases (matching) Matching repeated note – continues
Repeated note (high D) Spontaneous melody ascending and descending using rhythm - .. - -, .. - - -, .. - - -, .. - - - Using left hand	Accompaniment: Harmonic frame over 2 bars: D minor 7 D minor 7 G major 7 G major 7 D minor 7 D minor 7 G major 7 G major 7
Continues melody in left hand, bringing in right hand Same rhythmic pattern, same contour Alternate hands in pulse tempo (palm of hands on the keys – “flat hands”)	C major 7 C major 7 F major 7 F major 7 E major 7 A major 7 D major 7 G major 7
Begins to play with flat of both hands on keys	D minor 7 D minor 7
Goes out of tempo then recovers tempo	G major 7 G major 7 D minor 7 D minor 7 strong accents
Looks inside piano Single note melody in the style of the rhythm Both hands synchronous – “flat hands” Plays alternate hands, single note melody, one note to a beat	G major 7 G major 7
Fast melody on two notes, syncopated, matching rhythm Joel stops playing and pulls up a chair to the piano to sit down	C major 7 C major 7 F major 7 F major 7 E major . . .

In the second, lengthier improvisation reported in Table 12.2, Joel reveals an evident understanding of harmonic modulatory form and creates his own musical ideas within that structure. The occasions when he changes his material match with changes in the therapist’s harmonic frame because Joel is able to anticipate what will occur musically. This allows him to create his own melodic and harmonic structure that fits well with the therapist.

In the final improvisation, shown in Table 12.3, Joel demonstrates increasing autonomy of style, again matching and coordinating changes in his rhythmic production to harmonic structure. The most noticeable moment in this improvisation was when Joel waited while the therapist played a two-bar harmonic pattern (Section G) and then came in with a completely new idea (drum roll followed by triplet pattern).

Table 12.2 Second two-piano improvisation using harmonic frames

Joel (client)	*Therapist*
One-finger melody on the back notes, rising and falling phrases Continues one-finger melody	B♭ octave pulsed ground G♭ octave ground pulse leading to G♭ octave + D♭ accompaniment figure
Pulsed playing on black notes Matching tempo of pulse Single notes throughout but sometimes with both hands simultaneously. Rhythmic matching introducing chords, turn-taking, repeated notes, four more chords leading to . . .	G♭ major 6 G♭ major 6 B major 7 B major 7 G♭ major 6 G♭ major 6 D♭ major 7 D♭ major 7
Melody (black notes) up the piano + repeated chords Repeated chords, starts to slow down. Moves up piano	G♭ major 6 G♭ major 6 D♭ major 7 G♭ major 6 G♭ major 6 G♭ major 6 D♭ major 7 G♭ major 6
Pentatonic melody on black notes moves all the way up piano to the top, still in tempo (pulsed) Slows down significantly Bass notes – random, out of tempo	B major 7 G♭ major B major 7 G♭ major G♭ major . . . Transition using falling octave tritons Downward chromatic scale in the bass of the piano
Black note pulsed, step-wise melody high in the piano. Joel matches exactly the tempo of the accompaniment, but takes the lead with the melody	New accompaniment: 2 chords E♭ minor 7 A♭ major 7 E♭ minor 7 A♭ major 7 E♭ minor 7 A♭ major 7 E♭ minor 7 A♭ major 7
Stepwise downward melody in right hand	A♭ minor 7 D♭ minor 7 G♭ minor 7 D♭ minor 7
Sustains downward, pulsed, pentatonic melody Two hands melody – foot stamps Foot stamping – Melody – leads to . . .	G♭ major 6 G♭ major 6 G♭ major 6 G♭ major 7 B major 7 B major 7 G♭ major 7 G♭7/E♭ major 7
Alternate hands "flat hand" . . . synchronous fast rhythm anticipating jazz cadence Repeated note – waiting for the next idea	A♭ major 7 D♭ major 7 G♭ major 7 D♭ major 7
New dotted rhythm single notes in both hands "Flat hand" playing – moving down the piano, in tempo and matching the dotted rhythm pause . . . says "STOP"	G♭ major 7 G♭ major 7 G♭ major 7 G♭ major 7 B major 7 B major 7 G♭ major 7 E♭ major 7
Playing single notes in both hands Pauses . . . plays a final chord then giggles	A♭ major 7 D♭ major 7 G♭ major 7 D♭ major/G♭ major

Table 12.3 Drum and piano improvisation

Section	*Joel (client)*	*Therapist*
A	Plays windchimes once Rhythmic pattern on the skin and side of the drum: Quaver, rest, quaver Quaver, quaver rest, quaver, Quaver, quaver rest, quaver Repeats 3 times	Waiting . . . Then joins in on another drum with rhythmic matching, playing in the same tempo with complementary rhythms Develops into a rhythmic dialogue
B	Transfers to playing the windchimes Loses sense of pulse and tempo	Piano melody using Joel's rhythms Downward scale to a held note in the bass
C	Initiates and establishes previous rhythmic pattern in a fast 12/8 Transfers to other drums and cymbals As if playing a drum kit	Melody and accompaniment in A minor Establishes a 4-bar pattern to harmony: A minor A minor A minor A minor 7
D	- . - . - . - . rhythmic pattern alternating on 2 drums	D major 7 D major 7 A minor 7 A minor 7
F	Plays with rhythm of the piano melody Similar	E major 7 D major/E major 7 A minor 7 E major 7
G	Silent – waiting – comes in at the right moment after two bars – very conscious of musical structure here and previously Fast drum roll on the snare drum, followed by triplet pattern of beats	A minor 7 A minor 7 Silent Silent
H	Doubles speed – excited playing mainly on drum out of original tempo	D major D major A minor A minor
I	Leaves the instruments, throwing down his sticks, and dances over to the other side of the room to find a guitar	E major 7 D major 7/E major 7 A minor 7 A minor 7

12.6.2 Analysis using the improvisation assessment profiles

These three improvisations were then analysed according to guidelines established for the use of the IAPs as a general, qualitative tool (Bruscia, 1987) and as a tool for quantitatively recording target events in improvisations based on chosen musical parameters and profiles (Wigram, 2002a, 2004).

The data in Table 12.4 provided evidence of musical interaction and some emerging musical independence in the events scored in the leadership category. There was evidence of rigidity, particularly in the second improvisation, where Joel sustained a pentatonic, melodic idea that has been observed in other autistic children as repetitive “scale playing”. However, in Joel’s playing, he also incorporated rhythmic ground and tempo matching with the therapist, demonstrating musicality in his playing beyond that typically found in stereotypical and rigid playing. Looking at the overall scores on all musical elements, the number of leader events (22) compared with follower events (19) indicates a good balance, which is a healthy aspect, given the autonomous characteristics deriving from the pathology of autism. On the variability profile, the higher scores in variable playing (18) and the occasional contrasting event are also reassuring and encouraging as they demonstrate that, despite rigid and stable events (9 and 25 respectively), Joel has flexibility and adaptability in his improvisation style, supporting evidence of creative potential. Therefore the IAP analysis provided evidence of autism, but also of Joel’s strengths in intermusical and interpersonal engagement when using the medium of music.

Table 12.4 Summarized scores from an IAP analysis. Patient’s name: Joel; seven years old; autistic spectrum disorder. Section 1, first two-piano improvisation; section 2, second two-piano improvisation; section 3, drums and piano improvisation

Autonomy profile				*Variability profile*			
Section	*1*	*2*	*3*	*Section*	*1*	*2*	*3*
DEPENDANT				RIGID			
Rhythmic ground	0	0	0	Tempo	0	0	0
Melody	0	0	0	Melody	1	4	X
Phrasing	0	0	0	Rhythmic figures	1	2	1
FOLLOWER				STABLE			
Rhythmic ground	3	4	2	Tempo	2	3	3
Melody	2	1	X	Melody	2	3	X
Phrasing	2	3	2	Rhythmic figures	3	5	4
PARTNER				VARIABLE			
Rhythmic ground	2	3	2	Tempo	2	2	1
Melody	2	2	X	Melody	1	4	X
Phrasing	1	0	0	Rhythmic figures	1	5	2
LEADER				CONTRASTING			
Rhythmic ground	1	3	2	Tempo	0	0	1
Melody	1	6	X	Melody	0	1	X
Phrasing	2	5	2	Rhythmic figures	0	1	1
RESISTER				RANDOM			
Rhythmic ground	0	0	0	Tempo	0	0	0
Melody	0	0	X	Melody	0	0	X
Phrasing	0	0	0	Rhythmic figures	0	0	0

X signifies that no events could be scored

12.6.3 Therapeutic analysis to determine expectations

The analysis in Table 12.5 interprets events in the context of the implications for diagnosis and future therapeutic intervention. Here, the descriptions of what Joel was doing in relation to the therapist in these same three improvisations are correlated with previously defined "expectations of therapy" for this population that closely relate to identified pathological characteristics from diagnostic manuals. The evidence of creative musical interaction is linked to healthcare needs for children with cognitive and social impairments.

12.7 Conclusion

Musical structure in improvisation can provide a framework for creative development. It should be emphasized that more creative skills may emerge when a structure is given, in contrast with what one might see from an entirely free form of improvisation, where a lack of direction and model may leave the non-musician client struggling to find out how they can create music. Improvisation, musically structured or free, provides a complex source of

Table 12.5 Expectations of therapeutic intervention projected from events in therapy

Event in therapy	*Response and interaction with Joel*	*Expectations of therapy*
Piano duet	• Therapist accompanies and supports • Joel matches tempo and rhythm • Joel starts to reference me by looking	• Development of awareness • Development of concentration • Activating intersubjective behaviours
Piano duet 2	• Pentatonic improvisation • Joel references more and more • He moderates tempo and volume with me: from *f* to *p*, from *allegro* to *adagio* • Piano descends chromatically • Joel takes over melody • Joel starts moving his body • Joel initiates change – kicking his legs • Starts to vary – asks to stop • Recognizes a musical cadence: stops	• Shared and understood experiences • Tolerance of change • Flexibility • Entrained responses • Motivated interaction • Development of organization • Further shared experiences
Drums and piano	• Watching and working with therapist • Feels and plays the timing in the music • Breaks his own patterns	• Empathic synchronicity • Organization and structure • Spontaneous initiation of contact

data for analysis. The IAPs were developed as a tool for use in therapy, but the potential is there for a wider application in the field of music research. In the therapeutic process, this form of musical analysis (Tables 12.1–12.3) is useful initially, in order to code or verbally describe the musical events and to identify the characteristic elements of the music of both client and therapist. The example offered demonstrates how well an autistic boy was able to pick up and use a jazz frame. The way he was able to anticipate and initiate (frequently at exactly the correct musically timed moment) is evidence of his own creative skill. Many other musical styles and genres are used in improvisational music therapy to empower clients with a frame within which they can explore and develop their own creative expression, an expression that, it is argued, allows the emergence and resolution of issues and problems in some populations, and the development of strengths and abilities in others.

Creativity is a key process in improvisational music therapy, and nurturing it for the therapeutic benefit of different clients demands substantial skill and flexibility on the therapist's part.

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13 Aesthetics of creativity in clinical improvisation

Colin Lee

13.1 Introduction

Music therapy has entered a period of artistic renaissance. Within the burgeoning literature of empirical studies and the qualitative explorations of psychotherapy, music therapy has now turned its attention to the one element that makes it unique: music. The creative and aesthetic qualities of music are now being given equal weight in balancing the process and outcomes of music therapy. Aesthetic Music Therapy (AeMT) is a music-centred approach that considers creativity as fundamental. Through musical analysis, questions are raised about the future assessment of clinical improvisation. Creativity and aesthetic content proceed hand in hand as music therapy now becomes more open to new ways of thinking. This chapter defines a music-centred approach to clinical practice and the potential avenues of research that arise from attempting to understand clinical form from musical form.

13.2 Music-centred music therapy

Music-centred music therapy is an approach that was first recognized through the Bonny Method Guided Imagery and Music (GIM) (Bonny & Savery, 1973). Since the mid-1980s other forms of music therapy practice have been defined as music-centred (Aigen, 2005). Music-centred music therapy is theoretically and philosophically taken from the proviso that clinical practice can be informed equally by musical structures and theories as by psychological, psychotherapeutic, or medical ones. By studying and attempting to understand the role of music in the therapeutic relationship it is possible to begin building a theory of musical science (Lee, 2003a). The musical science of improvisation thus becomes a new and innovative way of redefining the bounds of clinical practice. Embracing musicological influences has still, however, to find equal status to other more traditional non-musical philosophies and theories of music therapy.

Understanding musical creativity as a non-verbal means of communication is at the cornerstone of music-centred music therapy. The creativity inherent in clinical improvisation allows for a sublimation of dialogue that

illuminates the balance between therapeutic and musical relationship that is often beyond words. Relationship is at the heart of the music therapy process and it is the therapist's understanding of the creative process that defines the developing aims of the work. Just as a psychotherapist interprets, either actively or tacitly, verbal contributions from the client, so a music-centred music therapist interprets the client's musical offerings. Thus in music-centred music therapy it is the music itself from which clinical interpretations and responses are made and understood.

The creative content of clinical improvisation in music-centred music therapy does not manifest itself through chance. The therapist must learn, and know how to use clinically, a broad range of musical resources. It is these resources that permit the client to experience creative freedom and form necessary for a valid clinical outcome (Nordoff & Robbins, 1977). Once the therapist has a wealth of clinical musical knowledge, they can begin to implement precise responses that are both of the moment and an accumulation of the therapeutic process. The technical musical precision of the therapist is what allows the client to experience their intrinsic creativity, which is not dependent on illness or pathology. Every tone, chord and rhythmic structure must have a defining role within the overall architecture of the improvisation and session as a whole. Thus the opening of creativity for the client comes from a background of conscious knowledge from the therapist, which can then be relinquished, but never abandoned, as the musical dialogue develops.

Defining music-centred music therapy is one of the most important developments in contemporary practice. A musicological analysis of clinical improvisation provides a factual science from which non-musical theories can be reassessed. Recent developments in music therapy research and practice have extended the bounds of clinical practice to include other allied professionals. Music medicine (Spintge & Droh, 1992) has matured to embrace physicians and psychologists. Their initiatives and knowledge enable the empirical assessment of music therapy to become ever more assured. This is crucial if music therapy is to survive as an intervention with a clearly articulated outcome. Similarly, music-centred music therapy is now open to ideas of musicologists, ethnomusicologists and music theorists. Music can be measured just as clinical control studies can be counted. The experimental nature of both models means that music therapy can now be researched with a similar rigour. By respecting equally theories of music and medicine, a creative balance can be found that will enable a greater understanding of the polarities of the "art" and "science" in clinical practice.

13.3 Aesthetic music therapy

Aesthetic Music Therapy came from a need to understand the musical foundations and structures of clinical improvisation within an explicit music-centred music therapy theory (Lee, 2003a, pp. 1–2):

> Aesthetic Music Therapy (AeMT) considers music therapy from a musicological and compositional point of view. Looking to theories of music to inform theories of therapy, it proposes a new way of exploring clinical practice . . . AeMT can be defined as an improvisational approach that views musical dialogue as its core. Interpretation of this process comes from an understanding of musical structure and how that structure is balanced within the clinical relationship between client and therapist. The therapist must therefore be a clinical musician. Clinical musicianship includes:
>
> - clinical listening;
> - clinical applications of aesthetics, music analysis and musicology;
> - clinical form and musical form;
> - clinical understanding of seminal works;
> - clinical relationship and aesthetics;
> - clinical analysis from a composer's perspective.

The creative components of improvisation are what make it such a dynamic force in the therapeutic relationship. Nordoff & Robbins (1977) entitled their approach *Creative Music Therapy* because they believed that every human being has the potential to be creative regardless of illness or pathology. The creativity of the therapist and their influence on the developing process are also at the cornerstone of their philosophy. AeMT is directly influenced by these beliefs. The creative potential of the client can only be released if the therapist is aware of the musical constructs they are using. By analysing and knowing the moment-to-moment expressive components of the music, the therapist is able to affect the creativity of the client and allow it to emerge. This sense of musical knowing is what makes clinical improvisation such a specific yet inventive science.

Music therapy to date has taken its structural underpinnings from non-musical theories. Psychological, psychotherapeutic, and medical indices have formed the basis from which assessment and research have developed. Allowing musical form to influence clinical form is a recent phenomenon. By analysing theories such as sonata and symphonic form, and linking them to theories of clinical form (Lee, 2003a), a new philosophy of music-centred music therapy appears.

13.4 Improvisation and composition

Composition and improvisation are allies. One even might say that they are one and the same. Nettl (1974) suggests that improvisation and composition, rather than being viewed as separate processes, should be seen as two points on a continuum. Just as music therapy is located on a line between "art" and "science", so the continuum between improvisation and composition should be open to and influenced by the ongoing therapeutic direction. Composition

is an ordered and specialized process. It is also a concrete and refined form of improvisation. Composition and improvisation are crafted yet free from the potential of preordained form. The spontaneous creation of improvisation produces a sense of freedom that is acutely therapeutic. The foundations of improvisation and composition are the same. Themes are stated and repeated, they are developed and presented to make a coherent whole. It is interesting to see how the structures of improvising are defined in Javanese Gamelan music (Sutton, 1998). *Garap* is to develop musical ideas, *cengkok* is the embellishment of melody, and *wiletan* describes the intricacies and understanding of melody. These terms show the importance of improvisational devices in other cultures and the emphasis placed on improvisation as a standard and accepted art form.

Form and structure balanced with freedom can be clinically captivating. Kartomi (1991) states that "since improvising and composing both involve workings and re-workings of creative ideas, they are essentially part of the same process" (p. 55). The sparks generated from the compositional character of improvisation and the improvisational character of composition makes clinical improvisation an exhilarating and compelling part of contemporary music. As the ability to improvise develops, so a sense of composition becomes ever more acute. Structure becomes embodied in the moment-to-moment expression of freedom.

Many great composers including J. S. Bach, Mozart, Beethoven, and Liszt were known to be accomplished improvisers. Schubert's style of composition can be seen to be similar to the creative process of improvisation (Nettl, 1998, p. 9). It is interesting to think of Schubert as a composer influenced by improvisation, and this raises the question of whether, if music therapy had been a profession in his day, he might also have been a clinician. That some of the great composers could have been music therapists is a fascinating notion and poses the further question as to why there are no influential composer/music therapists today. I believe the answer to this question lies in the fact that clinical/musical and clinical/compositional processes of music therapy are misunderstood and disrespected by the field of music. If it is true that music therapists are exceptional musicians and care deeply about music they use with their clients, why then are the links with the theories and profession of music so tenuous?

Begbie (2000, p. 182) in his discussion on composition and improvisation suggests that:

> the customary picture of improvisation as a discrete and relatively frivolous activity on the fringes of music-making might need to be replaced by the one that accords it a more serious and central place. Instead of regarding thoroughly notated and planned music as the norm and improvisation as an unfortunate epiphenomenon or even aberration, it might be wiser to recall the pervasiveness of improvisation and ask whether it might be able to reveal fundamental aspects of musical

> creativity easily forgotten in traditions bound predominantly to extensive notation and rehearsal.

If improvisation is to gain more respect in Western music, then what implications will this have for music therapy? I would suggest that the issues for music therapy in this equation are both complex and fascinating. There is a balance between the acceptance and appreciation of clinical improvisation as an art form and the scientific foundation necessary for the substantiation of clinical practice. How do we bridge the gaps between the organizational requirements of composition, the creativity of the client's expression, and the need to quantify and validate? Further, how do we evaluate clinical practice that does not deny the complexities of musical structure, innovation, and the boundaries set by extra-musical theories? These are engrossing questions because they challenge all music therapy theories that do not embrace music as essential to the process.

Berliner (1994) speaks of the division between jazz improvisation and composition as the eternal cycle. In jazz, composition and improvisation are allies. Improvisors learn and prepare "licks", patterns, and harmonic progressions that form the bases for the ensuing musical dialogue. In this regard jazz improvisation and clinical improvisation are similar. Clinical improvisers must have available a musical dictionary of ideas that can be used in the unfolding musical exchange. Jazz improvisers practise and rehearse models of practice that balance composition and improvisation dependent on their style. To be a competent jazz improviser, and also a clinical improviser, is to have a rich catalogue of formulas. Berliner (1994, p. 242) points out that:

> As soloists are perpetually engaged in creative processes of generation, application, and renewal, the eternal cycle of improvisation and precomposition plays itself out at virtually every level of musical conception.

When music theorists speak of the structure of improvisation, they are of course speaking from an artistic viewpoint. It could be argued that this has nothing in common with the complex dynamics of music therapy. It is my counter-argument, however, that when one compares the building blocks of improvisation with composition, the musical and extra-musical elements combine to produce illuminating results for both areas. Developing musical ideas as a result of a therapeutic relationship or as a result of a musical relationship have similarities. Paul Nordoff (Robbins & Robbins, 1998), as a composer and music therapist, thought of improvisations as huge dynamic compositional structures. These architectural constructions manifested themselves through his many styles of playing. He could be symphonic, emulate a sense of chamber music, or provide lieder with operatic or show-tune accompaniments. I believe that improvisation for Nordoff was a clear extension of, and was influenced by, his own composed music. Clinical improvisation and clinical composition are partners. It is the balance

between the two that leads to our understanding of the relationship between organization and the impact this has on the therapeutic process.

Improvisation as searching, rather than meandering – a phrase I recently elucidated in writings on composition and improvisation – is an illuminating concept that speaks not only to the struggles of clients but also to the therapist finding clinically and artistically appropriate music. Clinical improvisation, improvisation as searching, and the music therapy relationship combine to produce an authoritative experience that reveals the potency of music therapy. As the client searches to find their place in the world and in the musical interchange, so improvisation is able to reflect this open, extemporaneous path. To give the client the opportunity to explore freely, the music therapist must be both spontaneous and ordered. This is the paradox of the clinical/creative process. Improvisation as searching is the quintessential experience between composition and improvisation, freedom and structure in music.

13.5 Understanding the creative processes of seminal composers

Analysing and understanding the creative genius of seminal composers is at the cornerstone of AeMT. Gardiner's (1993) four-principle approach to creativity looks at the emotional, historical, and political background to the act of creating, considering the connection between the creator's childhood, their relation to others and their relation with their own works. By understanding a composer's life situation, their personal struggles and relationship to others, it is possible to make assumptions about the link between creativity and personal process. Many composers created their most profound works during times of personal crisis and loss. What does this say about the intense emotional nature of music and the ability it has to translate the human condition? This aspect of creativity has interesting links with music therapy and the relationship between therapist and client as co-creators.

In a recent publication (Lee, 2003a, p. 40), I pose the following questions:

> How . . . do we withdraw and find that which is significant from the investigation of seminal works? What connects the compositional and therapeutic process and how do we extract the essence of music and relationship that speaks to our evolving knowledge of music and people?

Further questions arise: Can creative genius be measured? What personal life situations affected their compositions? Is it possible to extract musical structures that could be adapted for the development of musical resources in clinical improvisations?

Great works of art can be perceived as being beyond rational comprehension. What makes a piece of music seminal is often beyond the structure of the notes themselves and is an expression of a composer's unconscious mind.

To wrestle with this concept and then make hypothetical links with clinical improvisation is a complex yet ultimately inspiring exercise. Through analysis of the notes themselves it is possible to find resources that can be translated directly to clinical musicianship and sessions themselves. What lies beyond the notes is, however, the mystery of artistic expression and the need to create.

The creative genius of J. S. Bach, for example, lies in a combination of religious belief, mathematical rigour, spirituality, and artistic integrity. For music therapy there are three levels of analysis in his works, which can be separated, but which live as expressions that are inextricably linked. First, the structural musical make-up of his music can be examined and distilled to develop musical resources. Harmonic sequences, rhythmic patterns, melodic motifs and architectural forms can be taken directly and indirectly and adapted in clinical improvisation. Thus Bach's distinctive compositional style can be brought into sessions for specific clinical/musical reasons. Second, one can look to musical relationships and translate this understanding to the therapeutic relationship. Bach's concertos are perfect examples of this phenomenon. How the soloist integrates with the orchestra and yet keeps a clear identity has parallels musically and therapeutically with the developing relationship between client and therapist. Third, an understanding of Bach's life situation, his balance between sacred and secular music, his religious beliefs and the connection between compositional creativity and personal growth gives a music therapist clear reasons for adapting his music with clients. All these factors conspire to bring the creative essence of Bach into sessions. Either as a specific musical resource in response to the musical dialogue or as a means to reflect a client's life situation, Bach's music can be a powerful tool in facilitating an effective therapeutic process.

Music therapy has yet to embrace the whole spectrum of Western music as a means to extend and interpret clinical musicianship. Composing and improvising have many aspects in common that could have distinct ramifications for the future analysis of the music therapy process and outcome. Creativity as an innate expression of the human condition depends not necessarily on genius, but on the availability of music to transcend illness and pathology. The ability to produce greatness in music, be it composition or improvisation, is a combination of originality and being alive. That clients are denied the opportunity to be thought of as great composers is to deny the essence of creativity itself. Once the barrier between client and composer has been dismantled it is possible to see direct links between the compositional and therapeutic processes. In validating and understanding each with equal clarity, clinical musicianship will become crucial in the development of clinical practice.

13.6 Aesthetic music therapy with a string quartet

The idea of working in AeMT with a string quartet came in a flash (Lee, 2003b). AeMT with musicians has the potential to:

- broaden the musical limits of clinical improvisation
- help further understand the balance between therapy and art
- explore a new way of assessing the musical/therapeutic relationship.

The questions became "how can sessions with a string quartet be defined as music therapy?" and "what of the creative balance between improvising as 'art' and 'therapy'?". Was I excited because I felt that working with a string quartet could mature my understanding of the therapeutic process, or was I supporting my need to work at a more sophisticated musical level as a clinical improviser? In truth, both considerations were true. Reflecting on the interpersonal and inter-musical dynamics during string quartet concerts, I began to speculate on the possibilities of how the therapeutic process might be useful to a quartet's concert work, as members of a chamber group and their individual needs as people. What direction might such work take, and how important would it be to find a clinical focus to the work?

Evaluating my experience as a clinical improviser and therapist, I began to formulate boundaries of clinical practice that would potentially allow such work to be identified as music therapy. The potential for new areas of practice is found in the most unlikely places, and it is these places that often provide the richest material. This is the only way contemporary initiatives will be found that will allow the profession to grow openly and creatively. What would be the potential health benefits for the quartet, and what learning experiences could I as clinician gain from this potential work? Could a greater understanding of creativity and improvisation be found? A professional string quartet has many pressures, in terms of both concert schedules and the intimate interpersonal relationships they must acquire. These pressures bring potential physical and emotional problems. It was my hypothesis that music could be used as a specific tool to deal with and aid these tensions. Through this work I saw opportunities for a broadening that would perhaps challenge the boundaries of what commonly constitutes clinical practice.

The Penderecki String Quartet, quartet-in-residence at Wilfrid Laurier University, agreed to take part in a pilot project of two assessment sessions. Their international profile and level of playing made them ideal musicians to work with on such a project. When listening to the audio recording of sessions (Lee, 2003a, CD 2, tracks 1 & 2), I can accurately recall the creative inspiration of being part of such dynamic music making. From the moment the first sounds began I instinctively realized the potential of this work. I remember my concern that I would be able to provide the level of musicianship necessary to explore the possible intricate workings they might need. I knew that the creative process through improvising was different to playing pre-composed music. Would they instinctively understand this difference, and how would their playing change when the creative channel between technique and emotion was opened? It was important that I identified my role in the music as one of therapeutic supporter/interpreter, playing as a music therapist and not an "art" performer.

Reflecting on these two sessions as a music therapist, composer, and improviser, I remember the revelation of improvising alongside these accomplished musicians. Once my concerns with regard to ability subsided I was able to dialogue freely. It seemed as if the music became one voice. The structure and form found its own level, as if the music had already been created. We seemed to be uncovering huge dynamic structures that were truly therapeutic in content.

From this work two main questions appeared (Lee, 2003a, p. 205):

- could clinical improvisation affect the quartet's playing outside sessions?
- how might the interpersonal relationships of the quartet be explored through the musical dialogue?

Music therapy and the string quartet may be closer allies than would at first be assumed. The string quartet is one of the most intimate and spiritual forms of music making. Are we not seeking to find that same spiritual centre in the therapeutic alliance? Could the music therapy process therefore learn from the precise processes of string quartet playing? Observing the physical, creative, emotional and physical cues during rehearsal and performance is not unlike the subtlety of communication between client and therapist. The musical relationship for both is about the smallest and most delicate of responses. How then might we begin to understand the mechanisms of each and the learning that may be possible? For some these connections may seem tenuous, but for me, as I hope for others, relating clinical practice to the practice and performance of chamber music may be one of the richest sources music therapy has yet to harvest.

The argument against this work could be that its referral comes from an ostensibly musical core. Could this negate the understanding and bounds that are considered clinical practice? The counterarguments are that the complexities of communication are unquestionably therapeutic and that the detailed investigation of such processes can evoke a further understanding of the music therapy relationship. Exploring and defining the nature of creativity that is an amalgamation of artistry and clinical intent is at the cornerstone of this work. The delicate and shifting balance between the intricate musical components of improvisation and its therapeutic significance is never more articulated than in this work.

13.7 Analysis and the aesthetics of creativity: Developing models of music-centred research

The aesthetics of creativity are fundamental principles in defining AeMT. Analysis of aesthetic content should be given equal status to the non-musical models that music therapy has primarily adopted to gain credibility. In presenting research that validates this belief it has been necessary to look to music analytic models of research. The clinical precision and empiricism

available through music analysis gives emphasis to the argument that musical structures can be counted just as can the empiricism of numbers necessary for control studies. It is the interpretation of data, and not the data itself, that gives the most illuminating results. Of course it is impossible to explicitly know and categorize the creative responses to music through numbers. That would be to deny the essence of music as a living and therapeutic force. What music analysis can do is expose the potential musical complexities that exist beneath the surface of clinical improvisation. It is these complexities, I believe, that hold the answers to the enigmas of music therapy. By investigating the precise relationship between musical and therapeutic frameworks a new level of understanding appears, which gives equal weight to the "art" and "science" of clinical practice.

Music analysis and the assessment of music in music therapy have always been rather shrouded in mystery. Nordoff-Robbins evaluation scales (Nordoff & Robbins, 1997) provided a way of critiquing the musical components in individual work with children. Bruscia (1987) includes consideration of musical components in his classification of music in the IAPs (individual assessment profiles). Ansdell (1995) provides a way of evaluating one small section of improvisation with comments that give a balance between the notes themselves and an interpretation. More recent research includes the work of Arnason (1998), who includes listening at six different levels.

My own research has been devoted to examining analytic approaches to gain a greater understanding of the musical and therapeutic processes in clinical improvisation. Initial evaluations looked at standard analytic models applicable to tonal music (Lee, 1989) and then atonal music (Lee, 1990). Following these investigations, I formulated specific clinical theories in order to integrate the questions under consideration (Lee, 1992, 1995). Following the preliminary research I formulated a nine-stage method of analysis, as follows (Lee, 2000, pp. 150–165).

- *Stage 1: Holistic listening*. Listen to the entire improvisation several times in order to obtain a sense of the whole. Alongside this, try to identify the musical elements, properties, structures or processes that are most significant to the fundamental character of the whole improvisation. Take general notes and listen on several different occasions.
- *Stage 2: Reactions of therapist to music as process*. The therapist writes a narrative on how they perceive the musical and therapeutic experience. This may include (a) how the improvisation relates to the client's process in music therapy as well as (b) what the therapist was feeling or thinking during or immediately after the improvisation.
- *Stage 3: Client listening*. Play the taped improvisation for the client and ask them to comment. Stop the music each time the client speaks and make note of exactly where in the improvisation they were moved to react. Record the conversation and make a complete transcription.
- *Stage 4: Consultant listening*. Play the taped improvisation for several

experts in different fields (e.g., a musician, psychotherapist, music therapist). There is no rule about whom to select. Again note exactly where in the improvisation the consultant was moved to react or comment. Tape record and make a complete transcription of the conversation.

- *Stage 5: Transcription into notation*. This stage depends on the music therapist's limitations with regard to both time and technology. One should keep in mind that there are many different types of notation and the way one notates is a function not only of expediency but also of one's conceptions (or perhaps bias) with regard to music. The notation can be as simple as a basic diagrammatic representation, through meticulous aural transcriptions, and ultimately computerized delineations.
- *Stage 6: Segmentation into music components*. Criteria for how the musical sections are to be identified must be established. Classifications of segmentation will allow the improvisation to be divided into manageable components so that more in-depth analyses can take place, e.g., changes in texture, formation of themes, changes in tonality.
- *Stage 7: Verbal description*. Itemize the musical elements of each section as formulated in Stage 6. Describe only those musical elements that are particularly striking or substantial. The description must be concise and should therefore not include every musical element. Emphasis is on conciseness.
- *Stage 8: In-depth analysis of segments and comparison of data*. Select a segment of the improvisation that received the strongest or most frequent reactions from the client and consultants. Consider this segment in relation to the entire improvisation. Describe how it fits, including what is the same and different between this segment and the rest of the improvisation.

  Analyse each segment in a comprehensive and in-depth manner. A variety of theoretical approaches may be relevant. Some analytical questions that arose from my research are:

  (a) Is there a harmonic cell?
  (b) Are there tonal centres?
  (c) Are there melodic motifs or characteristic intervals?
  (d) Are there rhythmic motifs or cells?
  (e) Is there a metric structure?
  (f) What are the characteristic textures?

  Compare the verbal data of the client and consultants with the musical analyses of the chosen segment. This should include the following:

  (a) finding areas of agreement and contradiction in the verbal data;
  (b) linking the content of the verbal remarks to specific musical locations, structures, elements, etc. – explaining what in the music may have accounted for a particular remark;
  (c) reconciling contradictions between verbal and verbal, verbal and musical, client and consultant, and client and therapist.

- *Stage 9: Synthesis*. Integrate all the above data and draw clinical conclusions pertinent to the information gathered.

The above stages, while detailed in content, can be used in simpler forms for practising music therapists. The question then becomes: how applicable is this work for clinical practice and/or research? With knowledge, an understanding of music analytic techniques, and the time needed to invest, it is possible to investigate the musical processes of work in general clinical practice. By investigating musical pivotal moments and/or sessions the music therapist begins to understand with greater clarity the musical nature of a client's creativity and how that directly impacts the therapeutic process. As music therapy research matures, an understanding of the musical "nuts and bolts" will become essential. Music analysis can be used as a part of other research questions or developed as its own unique research tool.

Further to this initial research I have focused on more general aspects of clinical practice in writings on supervision (Lee & Khare, 2001) and music-centred studies (Lee, 2003a). As music-centred music therapy becomes established, so music analysis will take its rightful place as a critical field of research. Future projects could include aspects of notation. How detailed do music transcriptions need to be to produce significant results, and is standard notation too restrictive to reflect the flexible essence of improvisation? What musical strategies are used in clinical improvisation, and what will music analysis uncover about the complex dynamics of the improvisational therapeutic relationship? How can the principles of outcome evidence-based research be paralleled with the potential empirical and process nature of music analysis? These and other research questions could change how the connection between process and outcome is evaluated. If the polarities are less separate than was at first assumed, what implications will this have for the future of music therapy research?

13.8 Closing thoughts

Music therapy is on the brink of new discoveries of practice and research. Looking to expand the bounds of what is considered clinical practice means that music therapy must be open to new and innovative possibilities. AeMT cross-examines the role and musical quality of clinical improvisation. The aesthetic content of a music therapy session allows or diminishes the creative potential for the client. Music that is vague and haphazard can only allow a diluted therapeutic process. However, music that is used with clinical precision and creativity allows for rich therapeutic outcomes. It is this bridge between aesthetic content and creativity that is at the cornerstone of AeMT.

The client's role in music is to be unfettered and free; to find the sense of creative freedom that will empower and help conceptualize their place within the world. Music has intrinsic form and shape. It also has the potential to be scattered and undefined. Understanding the musical elements developed by

the therapist is the platform from which the client can metaphorically perform their "song". It is this analogy of singing, of being able to express every aspect of one's living through music (Lee, 1996), that encapsulates the true essence of creativity in music therapy. Clinical musicianship is about clarity of musical choices made by the therapist. Allowing the creative moment to flourish is not something that happens by chance. It is a product of learning how musical elements are used therapeutically and in what combination they are then offered to produce the most exact therapeutic process.

By identifying music we identify that which makes musical creativity in music therapy such a dynamic force. It is those moments of opening between therapist and client that are so directly akin to the opening passages found in the great works of music. Moments of creative genius, I believe, are possible in music therapy, just as they are in the most ordered of compositions. In music therapy disability and genius are potential expressions along a continuum. It is how the music therapist respects these potentials within the ongoing musical framework that makes for greatness of clinical improvisation. If music therapy is to gain credibility within the field of music, it must show music of a high enough calibre to be respected both as a product of a clinical situation but also as music itself. If the music in music therapy can stand scrutiny to the same level as a contemporary composition, it will have achieved a status that will allow the work to be embraced in both health care and the arts.

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14 Hidden music

An exploration of silence in music and music therapy

Julie P. Sutton

14.1 Listening to the "nothingness" of music

According to Rowell (1983, p. 26):

> It is the "somethingness" that we usually attend to in music, not the "nothingness", and yet the uses of silence are numerous: silence may be mere punctuation or a minute interval between two articulated tones. It may be short or long, measured or unmeasured, interruptive or noninterruptive, tensed or relaxed. But in one way or another the silence becomes a part of the music.

Considering the power of silences within all human communication, it is surprising that most musical literature has focused on the phenomena of sound. As Rowell has noted, while the occurrence of musical silence is known, it is rarely documented in any depth and there has been a focus on the notes on the page rather than the spaces between the notes. One reason could be that apart from giving some indication of its duration, silence is incapable of accurate notation. Nuances of quality and intensity are impossible to score; while this is also true of notated sound, it is more critical for silence where there are no sounded reference points. Silences are not easy to study and can be complex and flexible, changing in mood and pacing (Sutton, 2001b, pp. 248–275). Clifton has likened attempting an examination of musical silence to that of trying to capture what is between forest trees (Clifton, 1976, pp. 163–164). While we may focus on the trees, it is the gaps between them that are essential in contributing to the structure and form of the forest. The relationship between musical sounds and silences can be described in similar terms; perhaps as with the forest, we will learn a great deal by looking at and listening to the spaces between musical sounds.

This chapter invites the reader to move from the "somethingness" of music towards its "nothingness", through exploring different aspects of silence in music, as well as in music therapy. It is hoped that this will also lead the reader to revisit and redefine some aspects of musical creativity. The author's experiences as a musician, researcher and state-registered music therapist are

reflected in this exploration. For example, research that compared the management of interaction in everyday conversation (improvised talk) and in free improvisation (improvised music) has shown how different the function and role of silence is in improvised talk compared to that in improvised music (Sutton, 2001b). From these findings, further thinking about the occurrence of silence in music is possible, including some aspects of the creative process. In terms of the applied use of music (within clinical improvisation in music therapy), the musical thinking in this chapter is drawn together with material from applied and developmental psychology. This is explored further in case material from clinical music therapy, which in itself provides a fresh perspective from which to listen to and think about musical silence. In these ways, from a balance of theoretical and applied stances, it is possible to consider music's "nothingness".

14.2 Defining "nothingness": The deathly silence

At this stage, it is appropriate to include a brief consideration of how *silence* has been defined. The scientific definition of silence relates to that which can occur in outer space, something that is not possible for humans to perceive. Experiments have shown that even if deprived of sound sources and in a sealed, silent environment, we become aware of sounds and sensations from inside our bodies. It would appear that sound (in the sense of our hearing being defined as the perception of vibration affecting our bodies) is an inescapable part of life. Even before we are born, our world is noisy; intra-uterine life is certainly not silent – it is full of a great deal of acoustic stimulation (Piontelli, 1992, pp. 34–38). From birth onwards, sound is all around us. It is an essential and unavoidable part of being alive. Even those who describe themselves as deaf are sensitive to the vibrations in the air that are registered as "sound" by hearing people.

From the beginning, life itself is associated with sound; therefore, connections between silence and death are also with us mere weeks after conception. The link between death and nothingness is apparent in the notion that silence can be thought of negatively, for instance in the idea that silences can hold the unspeakable. Apart from in death, a silence might be where we find the tension of something withheld (the absence of speech in a conversation), or something fearful (as symbolised in the film title: *The Silence of the Lambs*), or something threatening (the silence of birds and animals during a solar eclipse). Van Camp, a psychotherapist, observed that this quality of negative association with silence is also apparent in the art form of music, defining musical silence as "the unrepresentable affect" and linking it to that which is deeply traumatic (Van Camp, 1999, pp. 267–268). Dictionary definitions of silence also refer to negative qualities; that is, silence as an absence of sound. In contrast, in the East the term "silence" has also been linked with a sense of presence and accepted as something positive, with purpose and value. Despite these varying approaches to defining silence, what is

not in dispute is the general belief world-wide that silence is immensely powerful.

Other musical considerations of silence offer further perspectives. In notated music from the Western classical tradition, silences are visible in the score in the form of rests, pause points, and so on. Fleeting, unscored silences can also occur during the in-breaths of wind players or singers, or in the brief spaces that delineate the form of sound patterns. Silence therefore frames various aspects of music: music begins within the space before the first musical sound begins and ends with the space after the last musical sound has finished. Silence also frames each motif, theme or musical utterance, and longer silences can relate to form and structure. Finally, unheard silences may occur in single instrumental parts within a score. As Rowell noted in the quotation that began this chapter, silence is integral to music. Something of significance exists in music's apparent "nothingness", and further study of the phenomenon is not only valuable but essential.

14.3 Silence and music: What the artist chooses to leave out

It has not escaped the notice of authors that silence is an under-researched area of music, yet paradoxically it has been noted that some of the most powerful personal and musical experiences occur in silences (Peek, 2000, pp. 30–32). As stated above, a human perception of absolute silence is not possible. During an experiment in the Harvard University anechoic chamber, Cage's discovery of the impossibility of a total silence was a pivotal moment. From this realisation he developed a changed concept for silence: that silence was not in relation to sound, but to an attitude or state of mind (Cage, 1967). Combined with his experience of the Rauschenberg white paintings, the realisation produced the famous "silent" work *4′33″*, a work that related more to listening that to silence *per se* and therefore followed a broader contextualising of silence and music.

The significance of silence in music has been acknowledged by composers such as Nono, Stockhausen, and Pärt, who have at times conceptualised their music as emerging from and retreating back into silence (Smoje, 2003). This links the creativity within the composer's art to a broader concept of a continuity of silence out of which all music arises, is sounded, and, when finished, dies back into. This idea of an everlasting silence into which music is born and then dies can also create a sense of endless time within the music itself, as noted by Smoje (2003): "silence creates a sense of atemporality, erasing the sense of movement and with it, rational measurement of time". For composers agreeing with this perspective, the starting point for the creation of their music emerges from a spiritual and philosophical discourse, with *silence* becoming part of a deep, internal sense of oneself in connection with a wider, universal collective. One example of this mixture of personal motivation and theoretical thinking was Pärt's own withdrawal during the 1970s from serialism into a study of religious, contemplative music. This

was integrated with a simplification and concurrent deepening of his work, alongside the development of the technique of *tintinnabuli*, a concept that held his thinking about meditative silence. Pärt offers a broader view of silence, which relates more to philosophy and attitudes of mind than to any lived and experienced moments of silence. This is inextricably linked with an overall concept of creativity, where music emerges from an unknown place within the composer, access to which is dependent on quietness and stillness.

Musicians' thoughts about the process held in these silences before the music is made have been documented. In terms of the inspiration to create music, some composers have considered the creative environment necessary as being that of a still, separate, or silent space (Brahms, cited in Fuller-Maitland, 1911, pp. 69–70; Debussy, 1901, cited in Lockspear, 1958, p. 110; Ferneyhough, 1995, p. 260; Harvey, 1999, p. 166). In this sense, creativity itself emerges from silence, requiring stillness within the composer, a sense of separateness from the world, and space in which to flourish. Improvising musicians in particular have spoken and written about the silence before and after creating music. The experienced free improviser Prévost (1995, pp. 133–134) highlighted the function of silence at three points during improvisation:

> Silence at the beginning means not-knowing, not wanting to know, not wanting the music to move in a pre-ordained direction.
>
> Silence within performance marks the pivotal positions the music may reach.
>
> Silence at the end of a performance is not an end of a sequence at which there is a resumption of "normal" activity. The silence is a refined state of musical expression.

For Prévost, the creative act is inextricably linked with a state of unknowingness, a letting-go of conscious thought processes in order that there may be space and freedom for the music that is yet-to-become. Here there is also a focus on the very experience of hearing silence in relation to sound, as well as the overall perspective in which we hear improvised music as player and listener. The process of creating music would appear to be similar for composers and improvising musicians, involving a process of trusting the arrival of a creative moment of inspiration, behind which is a necessary condition inside the composer/improviser of waiting-without-expectation for the unexpected. Creativity, therefore, can be said to exist within this same process of trusting something both inside and outside the individual, where planned, thought-out acts have no place. Creativity would also appear to depend more on a sense of *being* felt deeply within the composer/improviser, out of which something else (the music) can *become*. For many, this process has its roots in silence. Here there could also be a metaphor for a broad view of humanity, where, since the origin of the species, individual lives emerge from and move back into an eternal silence. In this way, as with the reality of our sound-world and the links between sound as life and silence as death

discussed above, the eternal music and its underlying silence are another symbol for life and death. Creativity might also be seen as a paradoxical avoidance of and connection with life and death itself.

Returning to Prévost's words, that *pivotal* moments happen during silence, there is a suggestion of structural and aesthetic functions for musical silence. This idea has a close fit with the findings of the present author's research, where free improvised duets were seen to utilise silences at structural points, as a means of slowing the overall pace of the music, and for stimulating affective changes in the musicians and listeners (Sutton, 2001a, 2001b). In addition to the findings relating to the role and function of silence in creating musical tension, the author's research also uncovered changes in pacing and impetus in silences within a single musical work. While the research focused on free improvised music, the same was found to be true of all music. Clifton (1976, p. 181) has agreed with this, stating that:

> silence, since it is not nothingness, is an experienced musical quality which can be pulsed or unpulsed in musical time, attached or detached to the edges of a musically spatial body, and finally, which can often be experienced as being in motion in different dimensions of the musical space–time manifold.

One of the few musicians to discuss musical silence in any detail, Clifton also argued that silence was experienced by the listener as either anticipation or surprise and that this in turn was inextricably linked with maintained or increased tension (Clifton, 1976).

The cited work of these authors serves to provide further evidence for the significance of silence within music and also as an area of academic study. That silence has such validity was noted by the improviser Oxley in the first definitive publication concerning improvisation (Oxley, cited in Bailey, 1993, p. 89). Strikingly, while this published review of improvising musicians was comprehensive, Oxley provided the only reference to silence, which Bailey linked to a sense of space within an improvising group. Nonetheless, this single reference did recognise silence as a fundamental musical factor. A non-musician, Yen Mah (2000, p. 230), considered that the concept of silence was not only integral to all works of art, but also an essential and deliberately conscious act upon the part of the creator:

> I have come to believe more and more in the power and drama of phrases that have remained unspoken, spaces in pictures left blank, or chords *not* played in a piece of music. Sometimes, I am inclined to wonder whether the function of artists is not to create a scaffolding for that which has deliberately been left void and preserved as empty space.

If silence is defined in this way (as that which the artist leaves out), then there are two major elements to this aspect of the power of silence in a musical

work. The first is the inherent tension within what is unspoken, for instance when musical sound ceases and the momentum of the music is interrupted. This unexpected sound-absence disturbs the equilibrium of the listener in a profound manner, perhaps linked to the "unrepresentable affect" of which Van Camp wrote. At such moments the listener is left with an awareness of aloneness (death) and an associated need for sound (life). The second element concerns the space offered to the listener within which they will search to hear the unspoken. This aspect of silence is no longer receptive, but rather demands an active response from the listener. There is an inherent movement within such a concept of silence. It is a movement from response to reaction (from the outer to the inner state) and then to action (the inner to the outer). This theme will be revisited later in the chapter.

This overview of published literature has underlined the complexity and power of musical silences. However, in order to describe in more depth the relationship between this material and the work of clinical music therapists, it is necessary also to consider silence within human interaction. The following section provides the first link between these two areas.

14.4 Music and silence in early life

Psychologists have recognised for some time that early life has many musical aspects (Deliège & Sloboda, 1996; Stern, 1998; Trevarthen, 1980). A music therapist clinician-researcher, Robarts (1996), wrote eloquently about how these musical developmental experiences are carried with us through the rest of our lives, acknowledging the findings of a wide range of psychologists and making clear links between this and the clinical practice of music therapists. Describing the infant's emerging, organising sense of a world outside itself, Robarts recognised that this concept "is most pertinent to the music therapy process", because the affective states of early life have such strongly musical qualities (Robarts, 1996, p. 139). This observation echoes throughout much of the contemporary music therapy literature and serves to underline the therapeutic potency of the musical medium. As Robarts and others have noted, the to-and-fro of sound and movement that occurs between infant and care-giver has the musical qualities of melody, rhythm, timbre, dynamic, and so on. Occurring so early in life, this is not part of our cognitive being, yet it underpins all of human life. In this way, the experiences of the earliest stage of development are carried through childhood into adult life, where they continue to resonate in changes of feeling state. Using a computing metaphor, Damasio judged this to be our "hard-wired" inheritance, over which is written the "soft-wiring" of cognitive life (Damasio, 1994). Significantly, the musical aspect of this early developmental path is inseparable from our sense of security and safety within our first relationship. The musical beginning of life is interwoven with psycho-emotional emergence into a verbal world full of other people and things.

Developmental theory informs us that an infant will never have a completely

attuned care-giver all of the time (in the sense that its immediate needs will not be met for every second of every day). The experience of not having one's needs met in each moment is essential for later survival, although, paradoxically, it also renders the infant open to an overwhelming sense of threat to their survival. When the infant's emotional–physical needs are not met, panic and fear result. This is at such an early stage of development that it is impossible for the infant to process these sensations, which are not yet identifiable feelings. There is not yet the capacity to digest, name, and think about the experience. The infant can merely react to something that it has no understanding of, usually with an increased vocal dynamic (crying) accompanied by movement (wriggling or thrashing of limbs). When the care-giver responds (for instance, the mother taking her baby into her arms and making soothing noises), the infant calms. This, too, is an essentially musical experience. Yet until this moment the infant is alone and its distress is unheard. It is an experience of silence that appears to the pre-cognitive infant as threat to life itself: silence as a terrifying absence of security.

14.4.1 Silence in interaction: The tension of silence in improvised talk and improvised music

In common with the musical literature, the topic of silence is scarcely noted as worthy of study in the field of human interaction. While literature exists within the areas of psychology, psychoanalysis, and psycholinguistics, it is surprisingly rare when compared to the body of work. Jaworski, Tannen and Saville-Troike are rare examples from the psycholinguistic field (Jaworski, 1993; Tannen, 1995; Tannen & Saville-Troike, 1995). Each author made a strong case for further study of the complex phenomena to be found within silences occurring during interaction. Jaworski noted the complex and multilayered phenomenon of silence, drawing attention to paradoxical qualities when he wrote that silence is "probably the most ambiguous of all linguistic forms. It is also ambiguous axiologically; it does both good and bad in communication" (Jaworski, 1993, p. 24). Here Jaworski has identified not only that silences carry communicative intent, but they might also carry the most fluid and at times elusive and intangible material. To take this point further, it can be hypothesised that perhaps it is silences and not sounds that can best hold the paradoxes of human interaction.

The author's doctoral research (Sutton, 2001b) has explored the parallels between everyday conversation (improvised talk) and music (free improvised music). With few exceptions it was discovered that the management of interaction in talk and music was the same or very similar, yet when comparing the management of silence in conversation and free improvisation, there were striking differences (Sutton, 2001b). Silence in conversation was treated as a threat to the ongoing integrity of the talk, and something that must be repaired (Clark, 1996, p. 268). However, in music, silence had an integral role and function, relating to structure and pace, and also for creating tension in

the listener (Sutton, 2001b, pp. 267–270). Even relative silence within musical texture can be used as a means of relieving or creating tension. This is heard in many musical examples, whether in instrumental or vocal music, or the larger symphonic structures and opera. One example that reveals the way in which such relative silences can grasp the listener's attention is the opening of Mahler's Second Symphony. *Fortissimo* violin and viola *tremolandi* grow increasingly quieter, at which point a short semiquaver figure is introduced by lower strings (marked "wild" and "*fff*"). The quiet *tremolandi* continue, emphasising the lower string silence and increasing the tension. The lower string figure returns a minor third higher, after which there is a weighty silence before the semiquaver theme is extended and the music moves onwards. The overall effect is one of building tension and expectation through a single pitch *tremolando*, dramatic dynamic contrast, short melodic fragments of differing length and unpredictable breaks in musical sound – silences. It compels the listener to pay attention. The music begins in a fragmentary fashion that increasingly gathers momentum, as if drawing the listener further in. As stated above, these and other techniques are to be found throughout composed music, and whether or not silence is an active feature, it is always present as a background phenomenon.

To move from musical and conversational silences to those occurring within the therapeutic frame: while a fundamental aspect of the consulting room, the phenomenon of silence in therapy is rarely reflected in psychotherapy literature. Khan and Masud (1963), Slavson (1966), and Olinick (1982) gave differing perspectives, including silence as resistance, silence as communication, silence as a manifestation of early states, and silence teamed with the concept of therapeutic transference. The work of Maiello (1995) and Woo (1999) made connections between silent regressed states in patients and the earliest life stages. Goldstein Ferber (2004, pp. 319–330) considered silence in developmental terms, in charting the therapeutic process of a client for whom there were significant periods of different types of silence. These were described as "silent attunement", silences of intimacy, libidinal silences, mourning silences, "silences of mourning and acceptance", and, finally, short silences that could hold either closeness or distance.

These authors are from different disciplines, with their own approach to the topic; however, when the work of each is placed together, what emerges collectively demonstrates the importance of the phenomenon of silence within all interaction, all music and all therapeutic environments. It is a logical step to move from this perspective and introduce the area of music therapy, with a clinical example of silence.

14.5 Silence and music therapy

In the UK, clinical music therapy is a state-registered profession, established for more than four decades and growing out of the European free improvisation tradition. In music therapy, music is used in an applied manner, with

practitioners undergoing rigorous postgraduate training in many areas (for instance, music, music psychology, musicology, developmental psychology, clinical psychology, applied psychology). Increasingly, as theoretical dialogue is developing across disciplines, clinical music therapy research and practices are both informed by and informing the mainstream musical literature. While music therapists have always kept abreast of developments in musical theory, it is noticeable that mainstream musician-researchers are beginning to learn from the work of researching music therapist clinician-researchers. This marks a welcome discourse and a more recent but significant trend.

As with other disciplines, while music therapists experience and work with absences of musical sounds, very few have written about silence – and those that have tended to deal with the topic as part of a larger picture. For example, this is apparent in the more recent work of the well established clinicians Streeter (2002, pp. 267–269), Darnley-Smith and Patey (2003, p. 76) and Wigram (2004, p. 43). The pioneers Robbins and Robbins explored silence as a mean of creating different qualities of tension in composed music and suggested how this could be utilised by the improvising clinician (Robbins & Robbins, 1998, pp. 119–123). Bunt (1994) considered silence in different ways, both general and specific, stating (p. 51) that:

> Silence is crucial for giving space and significance to a sound and can almost be regarded as an element in its own right. Breaking a silence has both a physical and a psychological impact. Silence acts on the memory and can build up pleasurable feelings of expectancy – when is the next sound going to come? Sometimes silence can cause suspense and in some cases anxiety.

This range of the function and response to silence identified by Bunt is echoed in some of the music therapy literature, but, apart from a handful of clinicians, without an overall focus on the topic. Flower is one of a very small group that have considered the phenomenon in detail. Flower (2001) offered a clinician's view of the significance of silence, summarising three different aspects:

> Firstly, for the client the space between the notes and phrases may relate to and enable experiences of identity and separateness. They can hear not only their sounds, but also the responses of the therapist, bringing an awareness of self and other. Secondly, space [without actively making sound] allows the therapist room to think about, listen to and digest what it is that the client is doing. Thirdly, when both therapist and client are able to tolerate and create silent spaces, something in addition may be grasped about the nature of the connection between them.

Flower has examined a many-layered listening, including awareness of the communicative potential between each sound, what is contained in a silence,

and listening to and *feeling* the quality of connection that can exist between those sharing and negotiating the silence. In undertaking these kinds of listening there can be a heightened sense of awareness for both therapist and client. This is awareness of both self-with-an-other and self-alone, and it utilises silence as something capable of incorporating both presence and absence.

Informed by music therapy theory, Van Camp (1999) provided a broader theoretical canvas for thinking about silence in music therapy and music in general. In the remark about musical silence quoted earlier in the chapter, Van Camp, like Robarts, made a vital link between the disciplines of developmental psychology, clinical music therapy and the psychoanalytic literature; namely, that the ebb and flow of feeling-states can be likened to musical momentum. Rose (2004), a psychiatrist and psychoanalyst, has drawn these links together (p. 46):

> the concordance of formal patterns of virtual tension and release in the nonverbal art [music] appear to be attuned to actual patterns of tension and release in the structure of affect, resonating back perhaps all the way to the earliest nonverbal holding environment.

This is a statement with huge implications not only for the art form of music, but also for the profession of music therapy. It is what therapists, psychologists, and musicians have stated repeatedly, that there is a fundamental quality of music that is deeply rooted in the human condition. Van Camp took this argument one step further, making links between the musical phenomenon, silence and the traumatic, offering a rare and valuable outsider's insight ("outsider" in the sense that Van Camp is not a practising music therapist) into why music is particularly significant as a therapy (Van Camp, 1999, p. 268):

> Especially in those pathologies in which the bodily trauma had dissociated itself from the rest and is leading its own independent life or is threatening to do so . . . the music therapist has an important task. Since, with his music, he is operating on the same level as that which is traumatic, he is often the only one of all his fellow therapists to have access to the world of the patient.

The link between silence, the traumatic, and autism will be explored in the following sections of this chapter. At this stage it is relevant to note that Van Camp has identified a significant and unique place for the applied use of music (clinical music therapy) in the treatment of some of the most vulnerable members of our society.

The present author has also considered silence and music therapy (Sutton 2001a, 2001b, 2002b, 2002c, 2003), with current research exploring different kinds of silences in music therapy sessions with children with autistic spectrum

disorder (ASD)[1] (Sutton, in press). The concept of a process within a digesting silence has been explored, where the client holds a silence as an in-breath. This will be discussed in detail in the example of clinical work.

De Backer's theory of the *anticipating inner silence* is a notable exception to the lack of depth research in this area (De Backer, 2005). What is significant about the contribution of De Backer to music therapy research is that the material is strongly rooted in the musical art itself, while informed by analytic psychotherapeutic theory. The concept of *anticipating inner silence* develops new thinking about the silent state of the music therapist at the beginning of the therapy session. De Backer wrote that in this silence "the musician is already present in the music before the music sounds" (De Backer, personal communication). This idea also resonates in some way with composers such as Pärt, who broadened the definition of silence to include both the personal and the universal. Other types of clinical silence are also discussed by De Backer. These include the therapist's silence while the client is active, with discussion of therapeutic transference and countertransference issues. In addition, the fragmented silences of the client are considered, where there is an inability to sustain musical play and a breaking of the musical connection with the therapist as a result of an underlying, deep, fundamental trauma.

This brings the reader to another area with which silence can connect and that revisits the opening sections of the chapter: the traumatic silence of a fundamental "nothingness", not in the sense of a musical absence of sound, but of the silence containing a deeply felt absence of being. This is a fundamental feature of the autistic condition and is where a complex awareness of musical, personal, and therapeutic silence is essential. The following section of the chapter explores this.

14.6 Silence in music therapy with particular reference to clinical work with an autistic boy

Previous work by the present author has identified the occurrence of silence both in free improvised music (Sutton, 2001) and in clinical music therapy (Flower & Sutton, 2002; Sutton, 2001, 2002). While silences within conversation are usually considered to be a threat to the integrity of the talk, silences within music can have a function that integrates the structure, form and pacing of the music. In this section of the chapter, a clinical example of silence is discussed. To contextualise this example, it is necessary to present a brief overview of some theoretical considerations of autism. This material appears in the following two subsections, after which the clinical example is given.

14.6.1 Autism and trauma

It is widely acknowledged that the condition of autism (experienced by those on the autistic spectrum, or who have a label of ASD) is complex, and

changes over time. Most agree that identifying the condition centres on a so-called triad of impairments (Wing, 1993); namely, difficulties in verbal and nonverbal communication, in social relationships, and in developing play and imagination. Fitzgerald (2004) noted that there is a spectrum of autism across mainstream society, and argued that exceptional ability, eccentricity, and what is termed *autistic intelligence* can be seen in a number of renowned historic figures. People with ASD also share similarities with those who are described as traumatised, in that for the person with ASD, the world has become a bewildering, traumatic place (Alvarez, 1992). The early traumatic experience of the infant is never fully digested, and the autistic person remains vulnerable to being flooded by sensory input throughout their lives. The self-protecting filtering process that we all have is unavailable, rendering those with autism forever predisposed to being traumatised by the world and others in that world.

Donna Williams wrote in great detail about how it is to be autistic, exploring her sense of a constant anxiety level that is rooted in problems with filtering information through the senses (Williams, 2003, pp. 85–87):

> As a child I could see but processed everything bit by bit so only very small things were perceptually whole and most of the world was "in bits" . . . I was not only therefore, meaning blind, but also context blind . . . I also couldn't understand what people were saying. I was meaning deaf as well as meaning blind . . . My sense of self-in-relation-to-others was deeply disturbed . . . I thought body messages were frightening impositions knocking from inside for attention when I didn't know what they were saying . . . My systems were actually *all* cohesive somewhere, but when they reached consciousness, they fragmented under the weight of an information-processing demand I couldn't keep up with.

These words suggest an experience of the world and of others in that world that is traumatic in itself. The sensory overload and difficulties in filtering sensory information are reminiscent of the recollections of those traumatised by single events that are beyond ordinary life. In the same way that a traumatised individual will avoid any reminder or trigger of the traumatising event, so an autistic individual will withdraw from the world itself in an attempt to protect themselves (Reid, 1999). Added to this, the person with ASD also has fundamental difficulties in making sense of how people communicate and interact, which have their basis in what one young autistic client told me was *how to just get along with people*. In this sense, when one considers the traumatic nature of ASD, it is necessary to remember that this is threefold. First, there is the traumatic nature of living with a sensory filtering system that is frequently overloaded; second, there is an overwhelming vulnerability to misunderstanding and misreading all aspects of normal social interactions; third, the autistic behaviour resulting from these factors renders the person with ASD variously bewildering, puzzling, imperceptible, idiosyncratic, unpredictable,

and, at times, frightening. As well as having to cope with the world as a traumatic place on a day-to-day basis, the autistic individual can heighten feelings of a lack of security and safety in others, and thus the sense of trauma can spiral.

14.6.2 Autism, time, and silence

The autistic person will need a great deal of time and space in which to make sense of what is happening on the emotional level. Too much information presented too quickly can result in a feeling of being overwhelmed, confused, and chaotic. By slowing down interaction and actively working with silences there is the time and the space to digest what has occurred. This fits with several concepts from developmental psychology, such as *time-out episodes, retuning*, and *resettling* (Stern, 1977). Stern (1977, pp. 81–82) explained the concept in the following terms:

> A time-out episode consists of a relative behavioural silence, where there is both vocal silence and cessation of ongoing moments . . . The episode of engagement, and the subsequent time-out episode, appear to function as *retaining units* in the *regulation* of the interaction. During each episode of engagement, both mother and infant are trying to stay within the boundaries of the optional ranges of excitement and affect. The engagement episodes come to an end when an upper or lower boundary has been exceeded. More often the infant signals this.
>
> During the time-out episode, the interpersonal situation can be re-assessed . . .
>
> Each engagement episode . . . offers the opportunity of "resettling" the interaction on a different course. It is important to note that the time-out intervals are also potentially important *re-tuning* or *re-settling* moments. Very often the caretaker uses these relative cessations in the interaction to calm down the interaction.

The concept of *temporal shapes* (Alvarez, 1992, pp. 60–91) is also useful. This term refers to the pattern of responses made by people that have some connection with the early give-and-take between infant and adult. In the autistic person this pattern is either not present or unreliable, and it links to the lack of continuity-of-being that Donna Williams described. This has been recognised by authors from the clinical music therapy profession, over a range of theoretical perspectives (Brown, 1994; Levinge, 1990; Patey Tyler, 2003; Robarts, 1996; Warwick, 1995; Wigram, 2002). What emerges from these authors is the central task for the therapist, to offer a potential space where a sense of continuity can be facilitated for the autistic person. The argument from this author is that silences in particular can help achieve this.

14.6.3 An example of silence from a music therapy session with an autistic boy

Apart from exploring psychological theory from a number of areas (including music and developmental and applied psychology), trainee music therapists are introduced to concepts relating to different levels of listening. The way in which a music therapist listens to and reflects on the music made in the therapy room is central to the work. A therapist will listen in great detail to the unfolding series of sounds improvised by the child or adult client, and improvise their own music in response, sometimes together with the client, sometimes separately.

The following example occurred at the end of the third 30-minute music therapy session of a six-year-old autistic boy, Brian (not his real name). Brian was described as having great difficulty in interacting with anyone. He was a dreamy member of his school group, always alone, and hardly ever spoke. He did not make eye contact and was almost impossible to engage in terms of classroom work. When pressed, he was capable of protesting with great aggression, and it took two or three adults to contain these outbursts. Brian was able-bodied, stocky and strong, and in generally good health apart from occasional constipation (bowel conditions are not uncommon in autistic people; however, there is not the space to discuss this in detail within the remit of this chapter). During his three sessions in the therapy room Brian looked tense, frightened and anxious. He ran around the room, making a barrier of percussion instruments between himself and the therapist. At times he made the briefest of contributions, touching an instrument for a few seconds, making a short vocalisation, or glancing fleetingly at the therapist. In spite of the tentative, tenuous nature of his music, the therapist felt it was positive that he was intrigued enough by what was in the room not to leave.

14.6.3.1 Example: Brian's music and the therapist's responses

Brian played, moved, and vocalised in short bursts, flitting between instruments and different parts of the room. There was an overwhelming quality of his music "flying off" towards something else; almost before he had played, he moved away. There was nothing continuous in his music, apart from the fact that he did return to the instruments from time to time. Responding to what he offered musically required careful consideration. To match his fragmented playing too closely would be intrusive for him and would only add to the anxiety level in the room, but not to acknowledge his music would leave him abandoned. The therapist adopted an open, non-threatening musical atmosphere, improvising piano music that was predictable and slower-moving, with predictable, repeated chords that sometimes changed in reflection of Brian's short bursts of playing. A sense of continuity was offered in a simple melodic line. Gradually, a waltz emerged, its key of A minor both matching the tuned percussion tones and – more importantly – providing a

serious and at times sad and poignant mood. For the therapist this matched both Brian's mood and her responses to how he and she were connecting musically. The waltz pacing was flexible, often pausing at the ends of phrases, or when Brian was about to begin or finish playing. The idiom was selected because of its third beat, which allowed the therapist to "stretch" the music with flexibility, in order to help shape Brian's spontaneous responses. Gradually, Brian became able to sustain his music for increasingly longer periods. In doing this, he was revealing a less heightened state of anxiety and a slowly growing trust in the music making. Brian settled for a longer period of time at the metallophone, his music at times tentative, anxious, and tenuous. The intensity of his playing varied and in a way it was possible to hear how Brian "is" musically. The therapist shaped Brian's responses, waiting, holding back, pushing forward at different times. The aim was to provide some sense of continuity within which Brian's fragmented responses could sit. After almost 10 minutes, the music slowly drew to a close. There was a silence of almost two minutes, during which Brian gently placed his beaters onto the instrument. At the end of the silence he sighed and breathed out.

14.6.3.2 Discussion

The quality of this final silence was intense, and impossible to break until Brian breathed again. It was a silence that held the therapist's presence, and also some of Brian's, in a situation where he had found it very difficult to remain. It marked a passage of time where there was a definite sharing of time and space between Brian and his therapist, a space that he was just able to hold onto. There was also something both delicate and precious about this silence; it marked presence in the face of overwhelming absence. The silence also offered a space where it might be possible to assimilate and begin to process something of what had occurred within the musical sounds. It was a silence that was highly significant, because it was both within the therapist and also between therapist and child. In terms of Brian's therapy it was essential that this silence was held and not broken by his therapist, because it spoke silently of the future progress of the therapy (*i.e.*, the connecting to another person and the growing of a relationship). Alvarez has warned about ignoring the developing psychoanalytic space between the therapist and the ASD client as "like listening to music while tone-deaf or comparing the scent of two roses without a sense of smell . . . [the space between] is a relationship, a duet, not a solo" (Alvarez, 1992, p. 202). Perhaps the nature of this silent space in the therapist, and between her and Brian, was delicate and precious because it was also beginning to "be" in Brian, identifiably so in his need to hold his breath, and he held onto the experience of connectedness.

This example of one silence from a single music therapy session serves to underline what many authors and musicians have recognised about the potency and power of silences in music, silences between people, and musical

silences between people. The application of both musical and interactive theory and technique that is found within clinical music therapy is somewhere where silences can be far from "nothingness".

14.7 Summary and conclusions

This chapter has explored some aspects of silence in music and in music therapy, and has shown that silences can be heard and felt as presences and/or as absences. Just as with composed music, silences mark the time boundary of the therapy space. They might even become related to the overall shape or form of the session, or they might exist only as the defining characteristic for the time that therapist and client spend together. For the clinician, the silence at the beginning of a session can be a space for waiting-without-expectation, but with an openness to what might come, whatever it might be, where the therapist can take notice of feeling responses to the client and open themselves to the potential for a shared space. Winnicott (1971) wrote of the duality of such a space, where both separateness and togetherness could occur, giving the image of string that both separated and joined therapist and client. Rather than the silence being a lack of something between therapist and client, it is already beginning to define the presence of both. The stance of the therapist is an essential feature of this. A psychoanalyst, Kaplinsky (1998), noted that not only must the therapist be listening in this way, but without such a quality of listening there is no potential for the client's experience of being *listened to*. Music therapists know that even if making music at the same time, both client and therapist can listen and be heard, with many other aspects of the relationship also unfolding that can later be brought to consciousness. As Flower noted, silence also gives the therapist the space in which to digest what has happened and is currently happening in the musical sounds. In addition, composers such as Pärt have discovered that within silences we have the potential for links between inner and outer worlds. The observations of silences in clinical music therapy agree with this, but they also suggest there can be a two-way traffic, from outer to inner states and from inner to outer. Finally, silences in the clinical setting can be moments or longer periods of time where there is presence and absence, both individually and in the space within therapist and client.

The question can be posed: where does this leave us in thinking about silence and music? First, we can be clear that silence need not be thought of only as a means of creating a tension of expectation, and of catching the attention of the listener – or, of simply marking the beginning and the end of a musical work. Silence also has a deeper impact in the listener, which relates to perceiving or becoming aware of a sense of themselves in the moment. In applied musical situations, such as clinical music therapy work with autistic children, silence can create a processing space where time is stretched, and some sense of the child can be held onto by their therapist, where it is not possible for the child to do this on their own. In the sense of the therapist

"being there with" or "being alongside" the child, this is a silence that defines a presence that prevents an absence.

In pre-composed music, silences catch our attention; they stimulate expectation, tension, surprise, as well as at times serving a structural function. But a musical silence is not static, it is forever moving, and an agent of change. Silences are a powerful means for us to feel a connectedness with ourselves, during which we might find ourselves feeling many different things. Even in general terms an absence of sound within interaction is noteworthy, as Peek observed: "when humans choose silence [rather than speech], one must listen carefully" (Peek, 2000, p. 16). As demonstrated in this chapter, silence is unquestionably powerful within musical art. When these aspects of silence (those within human interaction and those within the art of music) are combined within the applied field of clinical music therapy, how much more potent the result can be. This demonstrates how exploring silences within both music and interaction reveals more about music. Such exploration also exposes significantly more about the human condition itself. Musical silences have potential to connect us with the deepest sense of ourselves, whether as a totally present being or with a deep sense of loss. Silences are not an absence of music, but a phenomenon within which creativity and music itself exist. In other words, silences are a hidden music to which we must listen most carefully.

Note

1 The author acknowledges the current definition of the autistic condition as autistic spectrum disorder (ASD); however, in terms of the text, the word "autism" is used as synonymous with ASD.

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Part VI

Neuroscientific approaches to musical creativity

15 From music perception to creative performance: Mapping cerebral differences between professional and amateur musicians

Martin Lotze, Gabriela Scheler, and Niels Birbaumer

15.1 General considerations

15.1.1 Creative music processing, composing, improvisation, and performing music

Making music means being creative, no matter whether you are composing a new piece of music, improvising, or interpreting a concerto on your instrument.

The creativity of a composer is expressed by their invention and elaboration of their musical ideas in a new way. The improvising musician spontaneously manipulates parts of musical elements in novel combinations. The soloist who performs a piece of music deploys technical skills, interprets the spirit and originality of the piece in their own creative way.

Being able to make music creatively implies some important requirements: one of these is certainly an innate, but also highly trained, ability to imagine a musical piece in relation to the expressive, emotional and, of course, technical details. Another is to select the most inspiring solution and transpose the image into the reality, which is also highly dependent on technical skills. Therefore creative processes are grounded on both musical experience and emotional associations.

A strong faculty of imagination in creative musicians is essential for creating inner representations of these cognitive processes, which can transmit the emotional and formal aspect of the music to the audience (Adolphe, 2001).

What about improvisation, which is supposed to be related to creativity in particular? According to considerations of Altenmüller (2003) auditory imagination is the most important element in this creative process and enables new musical solutions and plans. Improvising as an ongoing action needs fast reactions of temporal, sensory and auditory feedback and the decision as to the best solution has to come at the very moment of playing. A precondition for the transfer of the chosen musical version into an audible

result is the precise application of motor trajectories, which have to be trained extensively.

Elements of creative inspiration in performing music are often difficult to identify clearly and are not quantifiable. Inspired performance is based on selective recall of knowledge and recombination of known elements in a new context. The situation of a musician and their audience can be compared with an emotional communication process, resulting in a feedback loop characterizing a vivid, creative concert (Altenmüller, 2003). If there is knowledge common to both the performer and the musical listener, the recognition of musical elements within a new context results in a self-rewarding and delightful process.

15.1.2 Cerebral representations involved in music performance

Musical processes are so multifaceted that they obviously cannot be restricted to a particular part of the brain such as the right hemisphere, traditionally related to musical capacities. Different aspects of musical perception and production are represented in different areas within both hemispheres and subcortical regions. Whereas rhythm, articulation and interval-discrimination are processed predominantly by the left hemisphere, the memory for melody or the "colour of the sound" is represented in the right (for an overview see Tramo, 2001; for more details see Chapter 16 in this volume). A specialization of the left hemisphere for fast temporal processes within a 25 ms range – especially within the superior temporal lobe – and of the right for longer processes associated with the recognition of an envelope shape (250 ms) has been reported for language and speech recognition (Hickok & Poeppel, 2000). Various tactics are involved in dealing with a piece of music, dependent on the heterogeneous experience of people: an analytic procedure involves the left hemisphere more; a harmonic–holistic approach is processed predominantly in the right hemisphere (Altenmüller, 1986). Different knowledge bases can be accessed with increasing experience of hearing and playing music: a sensorimotor representation grounded on the movements will be mirrored in an internal repetition of motor programmes associated with playing the piece (Langheim, Callicott, Mattey, Duyn, & Weinberger, 2002). An auditory–holistic stimulus for harmony and melody repetition will activate areas predominantly in the right superior temporal lobe (Zatorre & Samson, 1991). A visual–perceptive stimulus on the imagery of the musical notes will activate bilateral visual areas, whereas a rhythmic representation or a structural syntactic view (Maess, Koelsch, Gunter, & Friederici, 2001) will predominantly activate areas related to linguistic–temporal processing in the left hemisphere. An emotional association may be centred in areas of the limbic or paralimbic system processing emotional valence (amygdala, insula) or arousal (thalamus, prefrontal; Blood, Zatorre, Bermudez, & Evans, 1999; Anders, Lotze, Erb, Grodd, & Birbaumer, 2004). All these different knowledge bases are located within different and overlapping cerebral areas and can be accessed in

the same temporal window (Altenmüller, Gruhn, Parlitz, & Kahrs, 1997). After approaching a musical piece from different aspects, not only is the scope of the knowledge bases increased, but also the representation sites activated during listening are more diverse. For instance, an association of melody with musical notes will access areas related to semantic processing.

There are several ways to investigate the anatomical and functional basis of musical creativity. One possibility is to compare brains of highly creative and uncreative people anatomically. These comparisons can be performed *post mortem* (an increased superior posterior temporal lobe in famous musicians was described by Auerbach at the beginning of the nineteenth century; see Meyer, 1977) but may also be achieved by examining living brains with functional neuroimaging including the possibility of examining creative abilities with neuropsychological testing. Since the quality of motor performance in musicians and their artistic skills are highly correlated (for an overview see Sloboda, 2000), musicians with a highly expressive interpretation are usually those who started early with training. Superior musical capacities may also be a pre-selection criterion, since those who are talented are receiving more positive feedback for their play and therefore train more. Extensive training time and the focus on work with the instrument cuts time from other activities. Therefore creativity may also co-vary with the restriction and a focus on a specific topic and specialization. If this specialization occurs early in life, musicians develop specific changes in brain anatomy as compared to age-matched controls who did not train their musical abilities: the gyral thickness and cortical grey layer of the motor representation of the non-dominant hand increases in the primary motor area (Amunts, Schlaug, Jaencke, Steinmetz, Schleicher, Dabringhaus, *et al.*, 1997) and the size of the upper limb representation sites in the cerebellar hemisphere increases in pianists (Schlaug, 2001). Furthermore, due to the fast interactions in both hemispheres during musical play, the connections between them increase, as has been shown for the anterior corpus callosum (Schlaug, Jaencke, Huang, Staiger, & Steinmetz, 1995). Additionally, secondary and tertiary motor areas such as the premotor areas and the anterior superior parietal areas are enlarged (Gaser & Schlaug, 2003), as are the auditory areas of professionals.

Functional imaging provides information about representation sites, area size, connectivity, and temporal processing by using EEG (electroencephalography), MEG (magnetoencephalography), PET (positron emission tomography), and fMRI (functional magnetic resonance imaging). With these methods, it has been demonstrated that not only the somatosensory cortical representation areas (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995) but also the auditory representation sites are functionally enlarged in musicians, especially for the specific frequency band width and musical timbre of the instrument (Pantev, Oostenveld, Engelien, Ross, Roberts, & Hoke, 1998; Pantev, Engelien, Candia, & Elbert, 2001).

The level of complexity of associations between different brain regions can be investigated using EEG-coherence and non-linear dynamic analysis. If

the complexity of the music (many changes between periodic and irregular patterns) is increased, the complexity of the EEG pattern of the listener in the prefrontal lobe (Birbaumer, Lutzenberger, Rau, & Braun, 1996) increases too. Interestingly, this increase is much higher in subjects who are used to listening to complex classical music: those who prefer popular music (less trained in musical complexity perception) demonstrate much less increase of EEG complexity during both tone and rhythm modulation. The majority of listeners prefer rhythmic modulations, which obviously pull their brain activity towards less complex periodic oscillatory response. Petsche, Kaplan, von Stein, & Fitz (1997) demonstrated that the involvement of different cortical areas and the complexity of cerebral connections increase dramatically when a person composes new music compared with when the same person listens to complex music. fMRI studies investigating musicians during improvisation demonstrated activation (retrieval) of frontal working memory areas in the right dorsolateral prefrontal lobe (Bengtsson, Czikszentmihalyi, & Ullen, 2003), active also during creative word searching tasks (Frith, Friston, Liddle, & Frackowiak, 1991).

In summary, an increasing amount of time devoted to musical practice results in specific changes in the functional and anatomical level of the brain. A general increase of cerebral activation does not necessarily mean that the subject is more creative, because this activity may be associated with basic motor and cognitive difficulties in understanding and motor performance of a musical piece. An increase of specific activation sites within primary sensory areas may be related to increased training time. The prefrontal lobe seems to be specific for those abilities generally associated with an increase of complexity in musical recognition and in those associated with an increase of creativity. For additional and more detailed information please refer to Chapter 16 in this volume.

15.2 Professional and amateur musicians during musical performance

We demonstrated differences in cortical and subcortical activation during musical performance of an overlearned versus a newly trained musical piece in a group of professional orchestra violinists and amateurs. We assumed that professionals could go along with an overlearned piece in a much more creative manner than amateur musicians, who struggle hard just to achieve the basic formal criteria of the piece. Furthermore, it is certainly an important preselection since professionals are existentially dependent on the quality of their musical playing: a professional who is not creative may not be able to be a member of a symphony orchestra, but a non-creative amateur can go on playing as an amateur. Therefore we did not additionally assess the creative ability of the professional and the amateur interpretation of the part of the concerto.

The professionals investigated in our own study had been trained and had

interpreted hundreds of different concertos. The other group had played their violin for a decade, but only occasionally for some hours per week. The two groups, therefore, differed substantially in the time spent with their instrument.

We hypothesize that the playing of the amateurs investigated may be creative if they improvise or if they are dealing with easy pieces, but, when confronted with a technically sophisticated piece, they may not be able to express their emotions or express musical creativity beyond trying to reduce technical mistakes. To study such a situation we selected the first 16 bars of the violin concerto in G major by Wolfgang Amadeus Mozart (KV216). This concerto is often used in auditions for professional symphony orchestras. It contains a wide range of technical difficulties, and requires good interpretational and technical abilities, but can be performed partly by amateurs with some years of training. The selected first 16 bars of the solo part require highly synchronized movements – for example, the fingers of the left hand have to move together to produce a vibrato effect; for trills, fast repetitive movements of one finger are required. This concerto is used for professional auditions not only because of these technical requirements, but also because it needs explicit knowledge of the emotional (artistic and affective) interpretation and different tempos.

Subjects were asked to execute only the left-hand fingering movements, keeping their right hands and arms as relaxed as possible. Given the limited space in the scanner, movement execution on a real violin was not feasible. To overcome this problem, subjects performed their finger tapping movements (together with whole-hand displacement) on their chests, which substituted the violin fingerboard.

15.2.1 Electromyography control of performance

It might be expected that professionals play faster, but activate fewer muscle groups during playing because they are trained to focus their activity on exactly the muscles necessary for the highly complex movements, such as the finger extensors at the lower arm. It has been demonstrated that after continued practice in motor skills, performance becomes more precise and automatic and that one gains dexterity as well as flexibility in adapting to changes and task demands. This often results in increased electromyography (EMG) amplitudes of the target muscles and a more precise coordination of movements (Seitz & Roland, 1992) including the suppression of associated movements of the other hand during unilateral movement execution (Rijntjes, Krams, Müller, & Weiller, 1999). This was also observed in our study: the professionals revealed increased EMG amplitudes compared to the amateur group. In particular, the left-hand EMG amplitude during motor execution correlated positively with the training time, underlining the relationship between performance and training as described above.

15.2.2 fMRI results of brain activation

Professionals perform more elaborately and they focus much more precisely on the hand that is involved in the task, being able to relax the right bow hand (which should be kept calm in our experiment) almost completely. It can be expected that the brain activity will mirror the peripheral data, demonstrating a more focused activation on areas relevant for actual execution for the left-hand movements.

fMRI studies investigating the performance of sequential finger movements reported that professional pianists, in comparison to non-musicians, show decreased motor activations within the supplementary motor area (SMA), the premotor cortex (PMC), and the ipsilateral primary motor cortex (iM1) during movement performances of varying complexities (e.g., Hund-Georgiadis & von Cramon, 1999; Jaencke, Shah, & Peters, 2000). With increased training experience, the contribution of the dorsolateral prefrontal lobe, known to be involved in early phases of motor training (Pascual-Leone, Wassermann, Grafman, & Hallett, 1996) decreases. Therefore an increase of prefrontal activation, expected to be essential for an increase in creative interpretation of a musical piece, may be decreased by the effect of less prefrontal load during well-trained musical performance. A shift of activation sites from a predominance in the prefrontal regions to the PMC (lateral Brodman area [BA] 6), superior posterior parietal (BA 7) and cerebellar structures within six hours of practice had been previously observed (Shadmehr & Holcomb, 1997).

Overall, a significant decrease of activation intensity within most areas related to motor control, apart from those of the contralateral primary motor cortex, was expected in professional violinists in comparison with amateurs during performance of the same musical sequence. Since an increased size of the anatomical motor hand area of the non-dominant hand has been described in professional musicians, this may go along with an increased involvement of this area during musical play. If changes associated with an increase in creativity could be observed in a direct comparison between professional and amateur players, this would probably be seen in another increase in regions activated. An interaction of musical performance and sensory feedback in a multimodal loop has been demonstrated by Bangert, Haeusler, and Altenmüller (2001). The combined auditory feedback and motor training, as it is experienced during instrumental performance, results in a co-activation of cortical auditory and sensorimotor hand regions, and such cross-modal co-activations are likely to expand with increased musical training. Therefore we expected an increase of sensory activity in the professional group.

Finally, we also expected increased activation in tertiary regions such as the dorsomedial prefrontal or the superior parietal lobe, which may integrate the internal plan of the piece, the sensory feedback and the actual motor performance.

An overview of the activation maps involved in left-hand performance of

the concerto in the two groups is shown in Figure 15.1. As expected, the representation sites evaluated during left-handed play of the violin concerto involve widely distributed cortical regions including bilateral primary and secondary motor areas, tertiary areas such as the parietal lobe, the prefrontal lobe only in amateurs, but also the auditory cortex (not shown) and additional areas in the cerebellum, the thalamus and the basal ganglia. Our observations support the notion that musical production involves not only the motor areas but also other functional systems (Altenmüller, 2001) such as the somatosensory, auditory, emotional, temporal, and memory loops.

There is clear evidence of differential brain activations in the two groups of musicians during executed performance: in general, professional violinists manifest fewer clusters of blood oxygenation level dependent (BOLD) signals.

Amateurs showed a more widely distributed sensorimotor representation in both hemispheres of the cortex and the cerebellum, weaker activations in the primary auditory cortex (A1), and increased prefrontal activation. Moreover, a more focused recruitment of motor areas was not associated with decreased EMG amplitudes during musical execution.

Figure 15.2 shows the differential brain maps for professionals minus amateurs. Activations within the right primary auditory cortex (BA 41; Heschl's gyrus) as well as the left auditory association area BA 42 were observed in both amateurs and professionals, although professionals showed higher

Figure 15.1 Amateurs (left) demonstrated more distributed representation sites (activation = dark) than professionals (right). The activation pattern ($p < 0.05$; corrected for the whole brain) of the professionals is centred in contralateral motor areas, bilateral SMA, and premotor and parietal activation sites (modified after Lotze *et al.*, 2003).

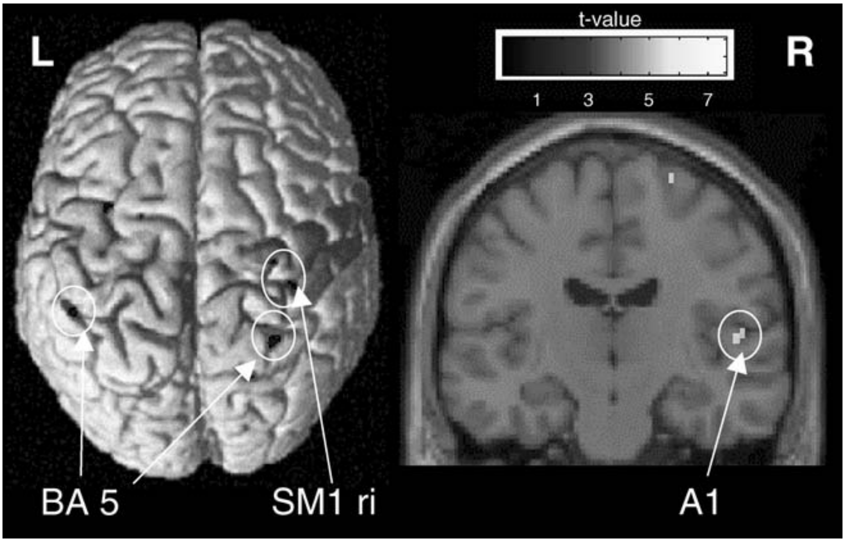

Figure 15.2 Professionals demonstrated increased activation in the contralateral primary sensorimotor cortex (SM1ri), bilateral superior parietal lobe (BA 5), and right primary auditory cortex (A1 ri). Exclusive masking; $p <$ 0.05 corrected for the entire volume (modified after Lotze *et al.*, 2003).

activity in the right primary auditory cortex. The right auditory cortex has been implicated to be dominant for perceiving pitch, harmony, timbre, and (to a certain extent) melody (see Tramo, 2001; Zatorre & Samson, 1991). As such, the higher activation manifested within this area in professionals may indicate an increased recruitment of stored auditory associations.

Nevertheless, the duration of training influences not only the quality of motor performance in musicians but also their artistic skills (Sloboda, 2000). It could therefore be assumed that our group of professional musicians might also be more expressive in their performance of the violin concerto. Sergent (1993) previously postulated that enhanced somatosensory and auditory feedback during performance on the instrument (e.g., strings of the violin) facilitates the online modification of movements and related sound production to meet the intended performance plan. As such, sensory feedback and close internal monitoring of the plan must be continuously activated. It can therefore be assumed that an increased sensorimotor coupling is particularly important for the quality of musical performance. These processes depend on close associative feedback–feedforward corrections between sensory (somatosensory and auditory) and supervising areas that establish the internal image and plan of the intended movements. The more musicians are involved in the aspects of motor performance, the less resource can be recruited for expressive–artistic features of the musical play or the correction of possible discrepancies between the intended and actual performance.

Prefrontal representation sites within areas that are involved, for instance, in strategy switches (BA 9), working memory or emotional modulation (BA 10) are only involved if conflict situations are present (e.g., Rogers, Owen, Middleton, Williams, Pickard, Sahakian, *et al.*, 1999). This is certainly the case in amateurs with a decreased precision of movement, but is presumably absent in professional players.

15.3 Increasing associative coupling in imagery

It has been demonstrated that brain activity exhibited by professional musicians differs from that of amateurs during the performance of the same musical piece. Imagery training in musicians leads to an additional training effect with regard to performance improvements and reorganization of brain representation sites (Pascual-Leone, Grafman, & Hallett, 1995). Furthermore, motor imagery improves the dynamics of motor performance – e.g., movement trajectories (Yágüez, Nagel, Hoffman, Canavan, Wist, & Hömberg, 1998). Consequently, the vividness of movement imagery is increased in professional musicians, with rhythm and pitch imagination scores correlating positively with lifetime and weekly training (Lotze, Scheler, Tan, Braun, & Birbaumer, 2003). Experienced musicians are known to employ motor imagery to improve their performance as well as to memorize the aesthetic–emotional concept of the musical piece. The mental imagery may therefore be an even more essential part of the creative process related to the interpretation of a musical piece. It has been reported that auditory imagery training improves the creative aspects of the ability to handle music during performance, and also composition and music perception (Adolphe, 2001). On a neurophysiological level a retrieval of musical knowledge is grounded in a reactivation of earlier neuronal pathways represented by the density of interneuronal synapses. By transferring familiar parts into a new context, former neuronal connections are reorganized with new neural assemblies (Bliss & Lomo, 1973). This recombination may be an important element of creativity.

Some composition teachers use auditory imagery training to increase the associative coupling between auditory neuronal assemblies and other memory traces that are usually predominantly involved in visual or semantic processes (Adolphe, 2001). It is conceivable that with increasing experience in mental performance, the activation sites related to motor imagery may also undergo systematic changes. Activations may become more focused and shift to tertiary areas that deal with more abstract, less motor-centred internal representation of the musical performance. Imagery training is especially useful when the motor process is already overtrained and automatized (Cumming & Hall, 2002; Gould, Eklund, & Jackson, 1993). A preplan of the movement by imagery is possible only if the movement has been internalized. After this internalization musicians profit especially when they mentalize difficult parts of the musical sequence for training. Therefore an increased

training in performance execution is the basis of profit in mental practice, resulting in an abstraction capacity that reduces training to its most essential parts (Orloff-Tschekorsky, 1996).

Langheim *et al.* (2002) investigated imagined musical performance and observed an activated network of lateral cerebellar, superior parietal and superior frontal activation. They concluded that this network is likely to coordinate the complex spatial and timing components of musical performance.

By comparing fMRI-activation maps of professional and amateur violinists during imagined musical performance of the first passage of Mozart's violin concerto in G major, we observed substantially lower BOLD effect in the professional group focused on very few cerebral areas, whereas amateurs manifested a widely distributed activation map, but scored their vividness of imagined movement lower (see Figure 15.3).

Professionals showed only some discrete increases: in the supplementary motor area, the superior premotor cortex, the cerebellum (not shown), and bilateral superior parietal areas (BA 5). An increased access to superior parietal and anterior ipsilateral cerebellar regions in the professional group may illustrate more efficient recruitment of stored sensorimotor engrams during imagery. Furthermore, an increased cerebellar access in the highly trained group may also be caused by an increased recruitment of temporal processes such as extracting the essential temporal information (Mathiak, Hertrich,

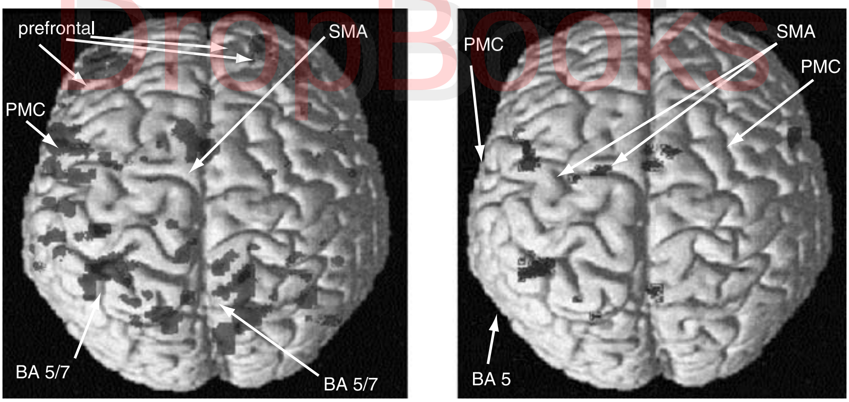

Figure 15.3 Mental performance of Mozart violin concerto in the amateurs (left) and the professional musicians (right). During imagery the amateurs involved a widely scattered activation map including bilateral superior parietal lobe (BA 5 and 7), premotor cortex (PMC), supplementary motor area (SMA) and bilateral prefrontal lobe. Compared to the execution task, predominantly primary motor and sensory areas are much less involved (see Figure 15.1, left). On the cortical representation sites, the professionals focused activity on the left BA 5, bilateral PMC and SMA, again quite consistently with the map activated during the execution task but with no primary sensorimotor contribution.

Grodd, & Ackermann, 2002) and the shaping of appropriate timed motor responses (Kawashima, Okuda, Umetsu, Sugiura, Inoue, Suzuki, *et al.*, 2000). In fact, the cerebellum may be a mediator within a circuitry for the sensory–motor system to process the incoming, ongoing, and feedback sensory information through which it extracts the essential temporal information, and shapes the appropriate timing of motor responses (Penhune *et al.*, 1998).

Although professional musicians report vivid imagination of melodic pitch during their usual imagery training, the right primary auditory cortex is not activated during imagined musical performance (Langheim *et al.*, 2002; Lotze *et al.*, 2003). During executed performance the primary motor and auditory cortex are tightly coupled (Bangert *et al.*, 2001) but this co-activation is completely absent if neither of the two areas is directly accessed in actual musical motor performance or listening to music. This absent auditory activity during imagined performance may also be interpreted as a result of the abstraction process, with activation in tertiary areas but not in primary. During concentration on the essential part of the musical sequence, areas dealing with stored movement programmes (cerebellum), movement trajectories (superior parietal lobe), coordination of bimanual movements with different movement vectories (premotor cortex), and temporal sequencing processes (SMA and cerebellum) are active.

Integration of the sensory-motor loop is especially important at the beginning of musical training – if it is stabilized, an abstraction process with mental practice seems to be useful for training (Mantel, 1999).

Amateurs demonstrated an increase in prefrontal areas that may be evoked by the unusual process of mentalizing interfering with an increase of processes involved in working memory and strategy work-out. Nevertheless, if activation maps during imagery were contrasted to those during musical performance, the two groups together revealed an increase of activation within the left BA 44, which has previously been described as being involved in imagery of observing trajectorial movements (Binkofski, Amunts, Stephan, Posse, Schormann, Freund, *et al.*, 2000). These activations can be interpreted as possibly demonstrating the location of the human analogue to the so-called mirror neurons active during movement observation and discussed as being involved in the process to learn movements by repeating internal movement programmes during movement observation and imagery. The internal movement repetition and the activation of the mirror neuronal system seems to be the area clearly distinct from those active during movement execution (Figure 15.4).

15.4 Conclusion

The question of how musical creativity is based on specific neuronal networks cannot yet be adequately addressed. We have described some correlates of neuronal specifications of professional musicians, based on the assumption that musicians who earn a living from performing music not only present a

Figure 15.4 A direct comparison of the activation maps of professionals and amateurs during imagery, minus during execution of left-hand violin play, revealed only activation within the left BA 44, probably in relation to "mirror neuronal activity" observed during imagery tasks previously (Binkofski *et al.*, 2000).

higher quality of rendition than amateur musicians and non-musicians, but are furthermore able to express themselves more creatively on the instrument. This approach allowed us to investigate professional and amateur violinists playing the same concerto with functional brain mapping techniques and to compare their cerebral representation sites. During an execution task these differences were characterized by a high concentration of the motor activation in the professional group, which freed up capacity for more intense sensory feedback control, demonstrated by increased auditory and superior parietal activation. The increased access to the described cerebral sites may lead to an anatomical increase of brain regions after decades of training, which has recently been demonstrated using volumetric imaging. We argue that these functional and anatomical changes may be a neuronal correlate for the quality of musical performance, which is essential to creative expression with the instrument, or is at least highly associated with it.

A more abstract approach with respect to musical ability was followed in our investigation of imagined musical performance. An increase of experience with this technique and with the instrument again resulted in higher economy of cerebral activation, which in this case was centred not in primary areas but in secondary and tertiary functional entities. An increased access to stored sensorimotor engrams during imagery may be related to the observation of increased activation within the superior parietal and anterior ipsilateral cerebellar regions in the professional group. Additionally the

imagery process is related strongly to an abstraction of the performance, concentrating on the most important elements for training complex sequences.

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16 Musical creativity and the human brain

Elvira Brattico and Mari Tervaniemi

16.1 Introduction

Any musical activity can be considered as creative since it encompasses an act of production of sound from silence. The best example of creativity in music is certainly musical composition. In general, composition may be described as the art of organizing sounds that by themselves do not have clear semantic associations in an original way that acquires or induces meaning either or both for the composer and the listener. As Schoenberg affirmed: "without organization music would be an amorphous mass, as unintelligible as an essay without punctuation, or as disconnected as a conversation which leaps purposelessly from one subject to another" (Schoenberg, 1967, p. 1).

Even musical performance becomes creative when it includes an evident amount of originality and thinking by the performer. For example, a creative performer may be differentiated by the novelty of their interpretation and by the communicative capacity of the music played. In particular, careful experiments demonstrate that the skilled interpreter reinvents the music within the limits dictated by the overall structure of the piece in order to convey emotions to the listener (Clarke, 2002). During performance the player is then interpreting the meaning of the composition in a way that the listener can understand and appreciate. According to Sloboda (1988, p. vi) there is an "inextricable connection of generative and receptive processes . . . All music must reflect the psychological propensities and capacities of humans as composers, performers, and listeners".

A more complete act of musical creation is accomplished by the performer who improvises. Improvisation has been classified as idiomatic when it can be identified as variations on a theme based on material with particular stylistic identities, such as in blues and jazz in the Western music tradition, or in the Raga-based improvisation of North Indian music. Improvisation can also be free or non-idiomatic, when it stems from a non-musical item, being then a product of a particular social situation or the development of an idea or abstract concept, such as occurs in classical contemporary music (Clarke, 2002).

Even musical listening can be considered as based on creative mental processes, especially when it requires an effort to extract meaning. In fact, beauty in a piece of art (often but not always considered the aim of a creative act) has been identified with the multiplicity and universality of its meaning (Carroll, 2000). Ambiguity is a crucial structural factor in the aesthetics of music. According to Besson and Schön (2003, p. 273), "there are always several ways to perceive and enjoy a musical piece". The process of meaning extraction is different from that of language: in music meaning is implicit and often difficult to identify whereas in language it is more immediate (except in poetry, which in fact has previously been associated with music; cf., for example, Lerdahl, 2003). Particularly in contemporary music, the effort to extract the idea of the composer or to associate the apparently disorganized mass of sounds with some familiar constructs is predominant in the listener, and thus maintains some similarities with creative thinking (Addessi & Caterina, 2000; Deliège, 1989, 1993; Deliège & El Ahmadi, 1990; Dibben, 1999; Kuusi, 2002; Lamont & Dibben, 2001). In Sloboda's words, "listeners grasp a work of music by attempting to sing or hum parts of it, or by engaging in some form of rhythmic movements. They may also 'compose' variants or elaborations of the music in informal (but not necessarily) overt behavior" (Sloboda, 1988, p. vi). In short, focused attentive listening to an utterly unfamiliar piece of music involves processes of memorization, association with familiar structures, retrieval from long-term memory, and mental representation, which enable the listener to recreate music in mind in order to infer (or actuate, in case of performance) the composer's intention (Arom, 2000).

In cognitive neuroscience, several methods have been used to elucidate how the brain processes music. First, in neuropsychology, the performance of patients with traumatic brain lesions or epilepsy is studied by using standardized test batteries in detail and the resulting test profiles are used as indicators of the relevance of the lesioned brain area for the particular task. Second, by using electroencephalography (EEG) or magnetoencephalography (MEG) one can reliably observe the cortically generated electromagnetic brain states and detect changes in them; for instance, as a function of experimental manipulation or musical expertise of the subjects. The data can be analysed in several ways. First, a technique that is attracting growing attention from scientists is coherence analysis. This measures the degree of electric coupling between any of the possible pairs of electrodes over the scalp used to record the EEG signal, thus permitting the quantification of correlation of time-frequency signals. Interestingly, while other methods allow localization of brain functions, the coherence analysis permits study of how activity from different neural assemblies converges for the accomplishment of a particular task (Patel, 2003). EEG and MEG signals may be also analysed in the frequency domain: from the continuous brain activity five frequency bands, each associated with a specific cognitive process, are filtered out. Finally, the most diffuse way of analysis of EEG and MEG consists of averaging

according to the temporal domain the epochs locked to the stimulus presentation or to the task performed by the subject. The resulting event-related potential (ERP) or event-related field (ERF) consists of subsequent deflections quantified in terms of amplitude, latency, topographic distribution, and possibly also current source models, each with a specific cognitive association. By means of ERPs one can track the order of the cognitive processes with millisecond accuracy.

Other techniques in neuroscience of music are positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), which can reliably determine the locus of brain activity even under the cortex. However, in the time domain, these methods are quite insensitive. PET and fMRI detect modulated brain metabolism, e.g., caused by experimental manipulations of cognitive demands or stimulation either during an experimental session or between the subject groups. In most of the studies a subtractive design is employed: the brain activities observed in two experimental conditions or subject groups are contrasted with each other, with the resulting brain maps indicating the statistical significance between these two measurements. The drawback of fMRI in auditory studies is that the recordings contain high-level acoustic noise (up to 100 dB), although this can be partially compensated for by appropriate stimulation arrangements (for a review of the neuroscience of music methods, see Tervaniemi & van Zuijen, 1999).

By means of those different techniques, cognitive neuroscientists are attempting to unveil neural circuits specifically devoted to singular human functions, such as language, music, and mathematics. Music being universally present in all human cultures and societies, we may hypothesize that it is hardwired in the human body at least as much as language or counting (cf. Zatorre & Peretz, 2001).

It should, however, be noted that relatively few neuroscientific studies have focused on musical creativity and expressive performance, or even on the emotions induced by or associated with music listening. This lack of empirical evidence can be partially attributed to methodological restrictions; namely, current neuroimaging techniques require experimental settings in which subjects stay in a steady position, avoiding any muscle movements including facial ones. Moreover, as underlined by Sloboda (1988), it is particularly difficult to find appropriate experimental controls over generative behaviour. In such circumstances, it has been more feasible to focus research on perceptual and cognitive functions.

Another reason for the lack of studies on musical creativity is theoretical. The dominant paradigm in brain research during the past two decades was borrowed from cognitive science and artificial intelligence and focused mainly on mental processing interpreted as symbol manipulation and on building a theory of musical representations. Only recently, with a naturalistically oriented paradigm shift, did the neural bases of musical performance also become of scientific interest (Leman, 1999). The recent biological approach searches for a causal explanation of musical behaviour as an

emergent consequence of the interaction between environment, neuronal synapses, and body states.

In the current chapter, we first review studies measuring brain activation during different types of creative musical acts, such as listening, performance or composition. Then we illustrate the brain structures, particularly in the right hemisphere, that are involved in music listening and production. Finally, we discuss experiments comparing musicians and non-musicians in order to search for the neurological factors distinguishing creative from less creative individuals. In this discussion we highlight the difficulty of defining, first, the role of training in the emergence of creativity in music, i.e., the necessity of distinguishing innate talent from learned expertise, and, second, what is genius in music and the feasibility of studying it with neuroscientific methods. Finally, we do not aim to search for a locus of creativity in the brain, in line with a modern phrenology,[1] but rather to understand what physiological factors enable one individual to be more creative than another, and possibly to indicate future lines of research.

16.2 Listening to music

We have proposed that listening to music may become an act of creation when it involves, apart from auditory abilities, imaginative, representational, attentional, and emotional behaviours in order for the listener to reach the composer's meaning or to create their own.

The sensory organs and the central nervous system enable us to receive a sound and to perceive, recognize, and memorize it. If the sound is presented within a musical context, we can also experience emotions and produce evaluative judgements of it (for example, whether or not we liked the sound or the piece). Within the brain, the auditory cortex is mainly involved in the receptive processes related to sounds (Hall, Hart, & Johnsrude, 2003). A general distinction may be drawn between the primary auditory cortex, in the deeper part of the Heschl's gyrus, and the secondary or associative cortex, including the planum temporale, the superior temporal gyrus, and other anatomical structures (see Figure 16.1 for details). In the following, we review studies demonstrating the complexity of the process of music listening. This complexity comes either from the extraction of the "meaningful cognitive and aesthetic experiences which can reside in memory for a lifetime that are musical melodies" (Patel, 2003, p. 342), or from the richness in brain activation following a music listening experience, or from the varieties of strategies that we can subjectively adopt during such experience.

16.2.1 Melodic structures

The experience of listening to a melody as a coherent and meaningful sequence of sounds with internal structural relationships is common to listeners, performers, and composers. Talent in classical, jazz, or pop and

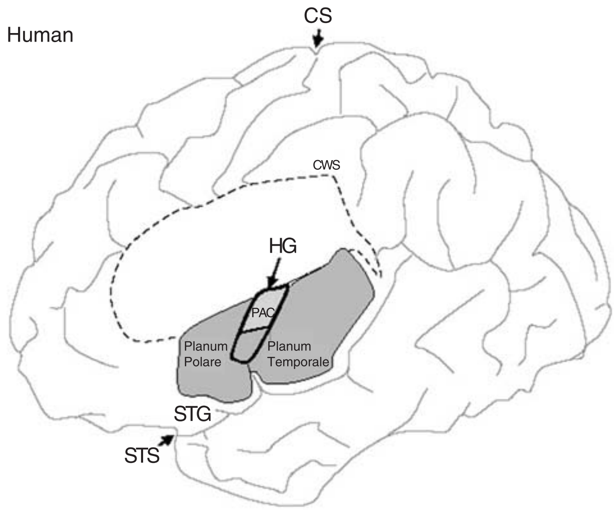

Figure 16.1 Schematic dorsolateral view of the human auditory cortex after removal of the overlying parietal cortex. The outline of the Heschl's gyrus is represented in black, with the primary auditory cortex (PAC) depicted in light grey. Secondary areas of the auditory cortex on the lateral part are shown in grey. STG, superior temporal gyrus; STS, superior temporal sulcus. Reproduced with permission from Hall *et al.* (2003).

rock composition is actually often identified in the ability to produce musical motifs and melodies that are interesting and, at the same time, immediately memorable to listeners. Consequently, for brain scientists, it is particularly relevant to reveal the physiological mechanisms underlying melody perception (see, e.g., Griffiths, Buchel, Frackowiak, & Patterson, 1998; Patterson, Uppenkamp, Johnsrude, & Griffiths, 2002; Schulte, Knief, Seither-Preisler, & Pantev, 2002; Zatorre, Evans, & Meyer, 1994). A first question is whether a melody is processed differently in the brain from a random sequence of notes, or, in other words, what is in the brain that makes us recognize and appreciate a musical melody. Zatorre *et al.* (1994) contrasted listening to unfamiliar tonal melodies with listening to acoustically matched sequences of noise bursts. Results showed that increases in blood flow, as measured with PET, during listening to melodies *vs.* noise sequences were localized in the right superior temporal and right occipital cortices. Moreover, an fMRI experiment (Patterson *et al.*, 2002) compared spectrally matched sounds that produced no pitch with sounds having a fixed pitch and with sounds forming a melody. All stimuli activated the Heschl's gyrus, in which the primary auditory cortex is located, and the planum temporale, in which higher-order associative auditory processing takes place. In the lateral half of the planum temporale, sounds with a fixed pitch produced more activation than sounds without pitch, while melodic sequences activated other regions

of the associative auditory cortex as well, specifically the superior temporal gyrus and the planum polare. These findings support the view that pitch processing occurs in a hierarchical fashion, the auditory activity spreading from the primary auditory cortex (involved in processing of isolated pitch) sequentially to anterolateral regions (devoted to processing of melodic sounds).

A second question that brain researchers are currently addressing is whether neuronal populations in the brain respond differently to melodies resembling those used in Western musical culture (and thus carrying musical meaning) and to acoustically balanced unfamiliar tone sequences (Brattico, Näätänen, & Tervaniemi, 2001; Carrion, Bly, & Rasch, 2003; Morrison, Demorest, Aylward, Cramer, & Maravilla, 2003; Patel & Balaban, 2000).

Patel and Balaban (2000) employed a sophisticated technique to investigate how the brain reacts to sounds manipulated in their organizational structure. Their experiment used sequences that varied according to probabilistic rules randomly choosing the sounds. The rule most closely resembling the one implicitly used in Western music ($1/f^2$) produced the most coherent electromagnetic activity in the brain, especially between the left posterior cerebral hemisphere and the rest of the brain. This suggests that sound sequences identified as musical produce characteristic patterns of coherent activity over all the brain, whether the observed larger coherence in brain activity over the cortex is a product of innate predispositions for the rules of Western melodies or the result of passive exposure to them.

These results are particularly relevant because they demonstrate a cerebral basis for the differential listening experience when a melody is perceived as coherent and familiar in its structure and when it is experienced as a random sequence of notes. Other experiments searching for brain differences between listening to excerpts from a familiar or unfamiliar musical culture were less successful in spite of behavioural differences in recall according to the musical styles, probably due to the different technique (fMRI instead of MEG) and experimental design used (Morrison *et al.*, 2003). It is nevertheless proven that listening to music that induces strong or simply pleasurable emotions may activate several brain structures devoted to emotional and motivational control, and this activation may be objectively measured with brain imaging techniques (Blood & Zatorre, 2001; Blood, Zatorre, Bermudez, & Evans, 1999).

16.2.2 Listening strategies

A given musical piece may also be listened to in several ways, therefore possibly involving differential brain processes and anatomical structures. For instance, Satoh, Takeda, Nagata, Hatazawa, and Kuzuhara (2001) investigated with PET the changes in cerebral metabolism while music students listened to either the alto part or the harmony of a motet by Bruckner. Their task was to detect the presence of the tonic or the dominant note in the

alto-part condition, and of a minor chord in the harmony condition. When the brain activity differences between these conditions were analysed, it appeared that the parietal lobules and precunei as well as premotor and frontal cortices were more active during listening to the alto part than to the harmony. In contrast, temporal poles, anterior cingulate gyri, occipital areas, and cerebellum were bilaterally activated during the harmony condition. The activation difference observed in parietal lobules can be attributed to the attentional demands in isolating the alto part from the larger auditory "object," while the higher involvement of the temporal poles in the harmony condition might reflect the neural circuits involved in retrieval of the minor chord category from long-term memory.

Additionally, an electroencephalographic study showed that the type of listening task might affect the brain responses to sounds (Brattico, Jacobsen, De Baene, Nakai, & Tervaniemi, 2003). During the experiment musically untrained subjects decided whether chord cadences were correct or incorrect (descriptive task) and whether they liked them or not (evaluative task). During aesthetic, evaluative listening, right frontocentral negative brain responses were larger than during descriptive, analytic listening, indicating distinct cortical mechanisms for the two listening modes in spite of their being evoked by the same musical stimulation and in participants with no musical education.

16.2.3 The role of the right hemisphere

The studies described above investigated the overall activation of the brain during musical activities, e.g., by measuring the simultaneous neural activation in the cortex during a complex mental task with the coherence technique, or by quantifying the cerebral blood flow with PET in order to study the clusters of activation throughout the brain. Other studies focused on testing the privileged role of one part of the brain, the right hemisphere, for music perception and cognition.

16.2.3.1 Evidence from brain mapping

Short-term storage and discrimination of pitch is a music-related function that seems to rely on asymmetric mechanisms. Two studies specifically addressed the issue of whether informational sound content (phonetic *vs.* musical) may alone determine the lateralization of short-term neural representation of sounds in the auditory cortex. The first MEG study (Tervaniemi, Kujala, Alho, Virtanen, Ilmoniemi, & Näätänen, 1999) focused on the mismatch negativity (MMN), a brain response indexing the accuracy of sound change discrimination in the brain. MMN, which is elicited after about 150 ms from sound onset by a slightly different infrequent sound among a train of repeated sounds, reflects the presence of a sensory memory trace for the repeated sound from which the infrequent sound was deviating. The

infrequent minor chord in a series of major chords elicited a larger MMN in the right hemisphere than the infrequent phoneme /e/ in a series of repeated /o/ phonemes. However, in the left hemisphere, no corresponding dominance for phoneme changes was found when compared with the other type of sound change. The second PET study (Tervaniemi, Medvedev, Alho, Pakhomov, Roudas, van Zuijen, *et al.*, 2000) based on a similar paradigm found that the vowel change was processed in the middle and supratemporal gyri of the left auditory cortex, whereas the chord change was processed in the supratemporal gyrus of the right auditory cortex.

These results point to a hemispheric specialization for phonetic *vs.* musical processing, already observed in dichotic listening and brain imaging studies using active tasks (Tervaniemi & Hugdahl, 2003). Interestingly, in the studies described here, the hemispheric lateralization was present even during the performance of a task unrelated to the sound stimulation, indicating its automaticity in the brain.

Speech and music also appear to have several processes in common. Since both basically consist of acoustic (time and frequency varying) information that can form highly complex cognitive hierarchies (Chomsky, 1957), one could assume that the same neural principles and networks cover the two domains. According to Besson and Schön (2003, p. 272), language and music "are rule-based systems composed of basic elements (phonemes, words, notes, and chords) that are combined into higher-order structures (musical phrases, sentences, themes and topics) through the rules of harmony and syntax." The possibility of aprosody (the inability to perceive and/or produce expressive prosody) as a counterpart of musical functions supports the similarity between neurocognitive processes behind speech and music. However, it has been convincingly shown that speech and music functions are highly independent. In fact, there are patients in whom one of these two faculties of cognition is spared despite serious deficits in the other faculty (Peretz & Coltheart, 2003). Therefore we can conclude that while these two modes of auditory information may share expressive, emotional neural substrates, they are more separable in their perceptual and cognitive levels.

16.2.3.2 Neurological evidence

Complementary support for the hypothesis of an asymmetric use of pitch and other sound information in the cerebral hemispheres comes from the observation that a musical attribute based on the fine-grained temporal rather than spectral resolution and encoding of sound events, such as rhythm, is mainly processed in the left hemisphere (Ehrlé, Samson, & Baulac, 2001; Samson, Ehrlé, & Baulac, 2001). The primary evidence was obtained from discrimination assessment of temporal processing of sequential auditory information in patients with left or right hippocampal atrophy: a deterioration of rapid temporal discrimination was observed only in patients with left medial temporal lobe degeneration (Ehrlé *et al.*, 2001). Similarly, tasks requiring the

discrimination of time-related microvariations within isochronous sequences or within real musical tunes revealed that epileptic patients with left temporal lobe lesions were impaired in rapid time discrimination (80 ms) as compared to patients with lesions in the right temporal lobe (Samson *et al.*, 2001).

16.3 Musical performance

In this section, we describe some experimental studies of musical production that have been enabled by the development of technical procedures permitting the imaging of brain activity while a person is playing music or imagining music.

16.3.1 Professional performance

The first experiment on musical performance was published in the prestigious journal *Science* (Sergent, Zuck, Terriah, & Brennan, 1992). The brain metabolic activity of 10 pianists was measured while they were asked to sight-read the score of a partita by J. S. Bach and play it with the right hand on a keyboard. Other conditions included visual fixation of the screen, listening to musical scales, playing the scales on the keyboard, responding motorically to dots presented on the screen, reading only the musical score, and reading a musical score while listening to its performance. When subjects read the musical score without listening or playing, the brain was bilaterally activated in the extrastriate visual areas, adjacent to the area activated by word reading, but not coincident since this was close to the dorsal visual system for spatial processing. In fact, in music, information present in the notes is derived not from feature analyses of the signs but from their spatial location in the score. When the musicians also played and listened to the music during reading, additional activation was found bilaterally in the superior and posterior part of the supramarginal gyrus in the inferior parietal lobule. The activation of the parietal lobe suggests that pianists performed a visual-to-sound mapping between musical notation and its corresponding notes. In fact, the brain region in the inferior parietal lobule was in the vicinities of the area responsible for visual-to-sound mapping during reading. Other activated areas were the left premotor cortex and the left inferior frontal area, immediately above the Broca's area, devoted to motor production of speech. Thus reading musical notation and translating it into movement patterns on a keyboard activate cortical areas adjacent to but distinct from those activated by similar verbal operations.

In Sergent *et al.*'s (1992) study the control stimuli for the music sight-reading task were simple dots not visually matching the musical score. A more controlled experiment was conducted by Schön, Anton, Roth, and Besson (2002), measuring fMRI activation during number, text, and music sight-reading tasks. Results showed that differential areas were activated by number and text as compared with music sight-reading in the parietal

lobe. Moreover, no extrastriate visual areas were activated, confirming the appropriateness of the control tasks.

A PET experiment investigated the brain substrates of bimanual piano performance *per se* (Parsons, 2003). In this case no sight-reading was requested. Pianists instead played with both hands either the third movement of the Italian Concerto by Bach or musical scales synchronously executed. Results concerning activation in the auditory areas showed that the temporal lobe was activated more strongly by Bach than by the performance of scales. Moreover, the performance of Bach activated the superior, middle, and inferior temporal areas predominantly on the right hemisphere, while the performance of scales activated only the middle temporal areas predominantly on the left hemisphere. Such findings may be ascribed to the different levels of difficulty in the two tasks and to the role of the right hemisphere in the reception and expression of melody, present in the music by Bach but not in the scales (see also Griffiths *et al.*, 1998; Zatorre *et al.*, 1994; Zatorre & Samson, 1991).

A pioneering EEG study investigated the coherence between brain areas during musical performance (Petsche, von Stein, & Filz, 1996). A professional cellist listened to a familiar piece of music, or imagined playing that music, or imagined playing scales. Both listening to music and mental rehearsal decreased the EEG coherence between several cortical areas, especially in the left hemisphere, whereas rehearsal of a musical scale decreased the EEG coherence more bilaterally. Additionally, the motor areas were cooperating with subcortical structures more intensively during mental playing of scales than playing of Bach. The authors also emphasized that for a professional musician, a mental playing task was not possible without parallel mental listening. The data suggest that both listening and mental playing modulate cortical brain functioning, and that the involvement of subcortical structures (in particular of the right as compared to the left hemisphere) is not equal during these tasks.

Recently, scientists also used electrophysiological methods to explore brain functions during actual playing of musical instruments other than the piano (Kristeva, Chakarov, Schulte-Moenting, & Spreer, 2003). EEG was measured while violinists were preparing to play, playing, or mentally rehearsing.[2] Despite remarkable interindividual differences, the motor areas in all subjects as well as the bilateral frontal regions in most of the subjects were functional in music execution in all its forms, that is, while preparing, playing, and imaging. The time course of the preparatory activity was not identical in all subjects or in all the brain areas of interest, but was always of the order of several seconds before music onset.

16.3.2 Neural basis of learning to play

Neuroscience of music also deals with how the brain mechanisms and structures are modified while one is learning to play a musical instrument. A

pioneering study used transcranial magnetic stimulation (TMS) to measure the modifications of sensorimotor maps in the human brain after learning to use the fingers, as is done when learning to play the piano. Pascual-Leone, Nguyet, Cohen, Brasil-Neto, Cammarota, and Hallett (1995) showed that training subjects to learn a five-finger exercise on the piano during a period of five days caused an enlargement of the cortical representation area targeting the long finger flexor and extensor muscles.

Besides motoric and perceptual skills, music performance also involves the ability to create a common, crossmodal map between these two domains. Recently researchers have tried to determine the properties of crossmodal brain processes during music production. It was shown with magneto-encephalography (MEG) that the mere presentation of familiar learned piano–music to pianists produced involuntary magnetic motor activity in the controlateral motor cortex (Haueisen & Knösche, 2001). Additionally, the silent tapping of a Mozart violin concerto by violinists and amateurs produced a co-activation in auditory regions (Scheler, Lotze, Braitenberg, Erb, Braun, & Birbaumer, 2001).

Consequently, scientists addressed how the multi-modal auditory and motor skills develop in the brain during training (Bangert & Altenmüller, 2003). Two groups of beginners were trained over a period of five weeks (10 sessions of 20 minutes each; two sessions per week) to play five piano keys. The control group had each piano key randomly reassigned to a different pitch after each training session. Changes in cortical activation patterns were induced after only 20 minutes, as measured during auditory and motoric tasks. These changes increased after five weeks of training, especially in the group with the right key-to-sound assignment. In particular, this group demonstrated significant additional cortical activation in the right anterior regions of the scalp (electrode F10), leading the researchers to conclude that this region is especially relevant in providing "an audio–motor interface for the mental representation of the keyboard" (Bangert & Altenmüller, 2003, p. 1).

16.3.3 Imagined musical performance

Imagination of musical performance has also been investigated with brain imaging techniques. Langheim, Callicot, Mattay, Duyn, & Weinberger (2002) compared imagined musical performance of six musicians contrasted with rest to bilateral finger-tapping contrasted with rest. In addition, the brain activity recorded during passive listening was contrasted with the brain activity recorded while listening to the same musical piece used for performance. Musical selections were individually chosen by each musician on the basis of familiarity and technical complexity. Imagined musical performance *vs.* rest activated several brain structures, such as the bilateral lateral cerebellum, the right inferior and superior frontal gyrus, and the right superior parietal lobule. This last structure has been associated with complex cognitive processing and information encoding/retrieval. The lateral cerebellum has been

associated with musical and motor timing, whereas the right inferior frontal gyrus is activated by tasks in which motor and musical-auditory maps are integrated for playing an instrument (Petsche *et al.*, 1996). Moreover, during bilateral finger-tapping bilateral primary sensory–motor cortex and medial cerebellum were active, differing in foci of activation from the cerebral and cerebellar activated regions observed during imagined musical performance. Finally, for the passive listening task auditory cortices were activated. In contrast, these areas were not involved during imagined musical performance, suggesting that this type of musical imagination does not require neural resources from primary sensory motor regions but rather from other associative brain areas. Moreover, in contrast with previous musical imagination studies (Halpern & Zatorre, 1999; Zatorre, Halpern, Perry, Meyer, & Evans, 1996), no higher auditory processing areas were active, probably due to the difference in the task (here physical musical production is imagined in addition to the sounds) and in the technique used.

16.4 Musical composition and related forms of musical productivity

16.4.1 Electrophysiological evidence

A first electroencephalographic study focusing on musical creativity (as opposed to music memory and analytic processing) monitored task-related brain activity of music students (Beisteiner, Altenmüller, Lang, Lindinger, & Deecke, 1994). The tasks involved memory recall of a well-known melody (memory task), or mental reversal of a four-note sequence (analytic task), or imagined composition of its continuation (creative task). In this study the analytic task evoked the largest electrophysiological activation in the parieto-temporal brain areas, whereas the creative task showed lowest brain activation, which was lateralized to the left hemisphere.

Subsequently, Petsche (1996) measured the EEG of subjects while they mentally constructed a short story (verbal task), drew a painting (visual task), and composed a short musical piece (musical task). Subjects of the visual task had been educated in an art academy and those of the musical task were professional composers. Coherence analysis of the EEG signal showed that, during all the mental tasks, functional cooperation between brain regions increased, especially in the delta and theta frequency bands. Results of the music task showed that cooperation between distant parts of the brain (between left frontal, temporal, parietal, and occipital regions, and right frontal, paramedian, parietal and occipital regions) is needed for composing. This suggests that besides independent activation of brain structures functionally specialized for processing of various aspects of music, as observed with PET and fMRI, synchronous activation of large parts of the brain is also needed for such a complex task as musical composition.

However, this study remains exploratory because it compared groups of

subjects of different educational background, age, and gender. Moreover, the method used mainly investigates the amount of synchronous neural activation between brain regions, thus not addressing other aspects of brain activity such as the amount of the post-synaptic current flow (measurable with EEG) and its location in the anatomical structures.

16.4.2 Neurological evidence

In terms of the scarce empirical evidence regarding musical expression and brain functions, few neurological studies are of interest. In clinical practice, physicians have observed automatic musical behaviour in epileptic patients. EEG studies of some of these patients helped reveal the neural mechanisms that underlie automatic musical production, i.e., a musical behaviour sharing some characteristics with the impulse to compose in expert musicians. For instance, a 31-year-old choir director, with intractable epileptic seizures in the right frontal lobe, manifested musical behaviour during the epileptic attacks including both thigh-slapping and singing, although not in synchrony (McChesney-Atkins, Davies, Montouris, Silver, & Menkes, 2003). After surgical resection of the right frontal lobe the patient was free from epileptic seizures but lost his perceptual abilities with regard to pitch and rhythm as well as expressive ones such as singing, consequently losing his job as choir director. However, his prosody remained intact. Based on this tentative finding, we might thus tentatively suggest that the right frontal cortex contains structures necessary for music production but not for speech prosody.

Bartolomei, Wendling, Vignal, Chauvel, and Liégeois-Chauvel (2002) obtained EEG recordings from three patients suffering from a particular type of intractable temporal lobe epilepsia that caused humming during epileptic seizures. The recordings showed that humming occurred when ictal activity in anteromedial limbic regions (usually devoted to the control of emotion and autonomic nervous system) was followed by rhythmic discharge activity in the most lateral regions of the superior temporal gyrus (where the associative auditory cortex is located). In particular, humming started a few seconds after the superior temporal gyrus discharge, a delay corresponding to the appearance of another discharge over the frontal region, and to the synchronization of the discharges between temporal and frontal regions (as measured by coherence analysis).

One of the most commonly cited neurological cases in music is that of the composer Maurice Ravel. The progressive cerebral disease of uncertain aetiology that affected his work and made him lose his creativity has been attributed by several neurologists (Alajouanine, 1948; Amaducci, Grassi, & Boller, 2002; Henson, 1988) to a primary progressive aphasia and a cortico-basal degeneration of the left hemisphere, in contrast with previous diagnoses of "ventricular dilatation", Alzheimer's disease, fronto-temporal atrophy, or focal cerebral degeneration. According to Amaducci *et al.* (2002), the two last musical compositions by Ravel (the piano *Concerto for the Left Hand* and

the *Bolero*) support the left-hemispheric degeneration hypothesis since those works are musicologically distinct from previous ones and are mainly built on rhythmic and timbral elements, predominantly controlled by the right hemisphere of the brain. Another case study of a composer, Shebalin, showed that receptive (Wernicke's) aphasia (the lost capacity to understand oral speech), together with alexia (inability to read) and agraphia (inability to write), also present in Ravel in the later stages of his disease, did not impair his creativity in music: he continued to compose pieces, even including a symphony, that were judged by other musicians as similar to the ones composed before the illness (Luria, Tsvetkova, & Futer, 1965).

Together, these findings point to the importance of the right hemisphere in expressing and encoding emotional sound information. Recent views attribute the hemispheric asymmetry in sound processing to the differential use of time and pitch information in the left and right hemispheres (for reviews, see Zatorre, Belin, & Penhune, 2002; Tervaniemi & Hugdahl, 2003). However, this hypothesis, emphasizing the importance of low-level cues for distinction between speech and tonal pitch processing in the primary auditory cortex, contrasts with another view suggesting that hemispheric differences arise as a consequence of domain specificity of speech versus music (Liberman & Whalen, 2000; Peretz & Coltheart, 2003). The most dramatic evidence for the latter view comes from studies of left-hemisphere activation in visual-sign processing in the deaf (Petitto, Zatorre, Gauna, Nikelski, Dostie, & Evans, 2000). Yet the two hypotheses may be combined, since the examples of domain-specific processing involve regions outside the auditory cortex, such as the frontal lobes, whereas neural specializations for spectral *vs.* temporal cues may occur in a lower stage of sound processing (Zatorre *et al.*, 2002).

Moreover, the right hemisphere has often been associated with processing of holistic activities such as musical creation, in contrast to the left hemisphere, which is devoted to more analytic thinking. By investigating brain-lesioned patients, it has been shown that several expressive functions may originate from the intact functioning of right-hemispheric areas. Likewise, purely perceptual encoding of musical attributes, such as timbre, virtual pitch, and consonance, has been shown to depend on intact right-hemispheric functions. Even expressive part of speech encoding or production (emotional prosody) often deteriorates after a right-hemispheric lesion (Milner, 1962; Samson & Zatorre, 1988; Shankweiler, 1966; Zatorre, 1985). These results are confirmed by EEG and brain imaging measurements on healthy subjects during processing of emotional intonation, showing consistent activation in the fronto-temporal regions of the right cerebral hemisphere (Pihan, Altenmüller, & Ackermann, 1997; Pihan, Altenmüller, Hertrich, & Ackermann, 2000; Wildgruber, Pihan, Ackermann, Erb, & Grodd, 2002).

Milner (1962) and Shankweiler (1966) first showed impairments in melodic discrimination after right but not left temporal lobectomy. However, similar deficits are also possible with lesions in the left temporal lobe, but only when

they include the Heschl's gyrus (Samson & Zatorre, 1988; Zatorre, 1985). Bautista and Ciampetti (2003) reported a case study on a 43-year-old individual suffering from epileptic seizures of right temporo-occipital origin that caused flattened prosody (aprosodia) and difficulty in singing (amusia). After adequate pharmaceutical medication for her epilepsy, the symptoms of both amusia and aprosody disappeared. This case provides supportive evidence for the role of the right hemisphere in generative musical behavior.

16.5 Musical expertise and creativity

16.5.1 Musicians vs. *non-musicians*

The growing number of comparative studies on neurocognitive processes of musicians *vs.* non-musicians are of interest in the perspective of the present review, since they compare subject groups involved or not in creative musical activities and may thus provide useful information about the neurological factors determining a musically creative or non-creative individual.

16.5.1.1 Evidence from brain mapping

The musician's brain may be considered as a perfect model for studying cortical plasticity (Münte, Altenmüller, & Jäncke, 2002). Consistently, it has been shown that musicians' brains react to sounds more efficiently and faster than those of non-musicians (Pantev, Oostenveld, Engelien, Ross, Roberts, & Hoke, 1998; Pantev, Roberts, Schultz, Engelien, & Ross, 2001; Shahin, Bosnyak, Trainor, & Roberts, 2003). In particular, musicians have facilitated brain responses occurring at about 100 ms after sound onset to spectrally complex sounds over pure sinusoidal tones (Pantev *et al.*, 1998) and to the timbre of their own instrument over other instrumental sounds (Pantev *et al.*, 2001). This indicates that the increased reactions of neuronal populations in the auditory cortex regions may be learning-induced.

Notably, musicians possess more efficient neuronal networks not only at the sensory level of perceptual processes, as evidenced by the results of Pantev *et al.* (1998, 2001), but also at subsequent cognitive levels of auditory processing. Such evidence has been obtained in studies of short-term (Brattico *et al.*, 2001; Koelsch, Schröger, & Tervaniemi, 1999; Tervaniemi, Rytkönen, Schröger, Ilmoniemi, & Näätänen, 2001; van Zuijen, Sussman, Winkler, Näätänen, & Tervaniemi, 2004) as well as long-term memory (Besson & Faita, 1995; Besson, Faita, & Requin, 1994; Besson & Macar, 1987).

As mentioned above, it seems that musicians have also developed more efficient neural mechanisms for sound-change discrimination. These mechanisms rely on a faster and more robust memory trace for repeated sound events. In neurophysiology, such a memory trace may consist of the formation of new synaptic connections or of old connections facilitated or inhibited by genes regulating molecule production in the synaptic space. In musicians,

macroscopic electrophysiological measures seem to indicate enhanced memory traces for complex sounds: for example, violinists' brains are able to discriminate a tiny variation in repeated chords even without the intervention of attention (Koelsch *et al.*, 1999). Moreover, the auditory system of musicians automatically encodes acoustically varying patterns constant only in the number of their tonal elements, as reflected by an MMN brain response evoked by the infrequent added element in the pattern (van Zuijen, Sussman, Winkler, Näätänen, & Tervaniemi, 2004).

With the aim of studying neural correlates of long-term memory for music, in a series of experiments by Besson and coworkers (Besson & Faita, 1995; Besson *et al.*, 1994; Besson & Macar, 1987) participants were asked to listen to some melodies and evaluate the appropriateness of the ending sound as compared to the preceding musical context. Results showed that ending sounds having a pitch, rhythm, or harmony discrepant from the preceding context elicit larger positive electric brain responses (the so-called P3) than less discrepant ones. Moreover, the electric brain responses to harmonic, melodic, and rhythmic violations of familiar musical excerpts were larger in musicians than in non-musicians (Besson *et al.*, 1994; Besson & Faita, 1995).

Bhattacharya and Petsche (2001) tested the degree of cortical synchronization during listening to music in musicians and non-musicians. They found that musicians showed a higher degree of phase synchrony in the gamma frequency range, but not in any other range over all the brain, than non-musicians. In a control condition in which the groups were listening to a neutral text, their degree of synchrony did not differ. Additionally, a left-hemispheric dominance during listening to music was found in musicians, whereas in non-musicians a right-hemispheric dominance was found during text listening. These results were interpreted in terms of a higher ability in musicians to retrieve musical patterns from their acoustic memory, an ability possibly reflected in the gamma band oscillations of the EEG.

As seen above, a majority of the studies on neurocognition of musical expertise have focused on instrumentalists. However, one of the most admired groups of musicians, in modern times, is conductors, who are able to reproduce masterpieces by their extensive knowledge of musical repertoire, and by their efficient methods for integrating sounds produced by a large group of individual musicians into coherent and synchronized performances.[3]

Recently the cerebral responses of conductors were investigated by electric recordings, which enabled the researchers to index the accuracy of both automatic and attentionally controlled auditory processes. Of particular interest was the comparison of neural accuracy of conductors in their spatial attention with that of pianists without conducting experience, and of non-musicians (Münte, Kohlmetz, Nager, & Altenmüller, 2001; Nager, Kohlmetz, Altenmüller, Rodriguez-Fornells, & Münte, 2003). To this end, participants were to listen to sound bursts from an array of nine loudspeakers placed in a semicircle in front of them. Nager *et al.* (2003) found that, as indexed by a P3a component of the ERPs, misplaced noise bursts attracted involuntary

attention more sensitively in conductors than in any other subject group. They also found that the sounds originating from the attended loudspeakers were more elaborately processed by conductors than by the other musicians. More specifically, while in all subject groups an enhanced Nd[4] was elicited by the target loudspeaker sounds among the three central loudspeakers, only in conductors was the Nd effect spatially locked to the target loudspeaker in the peripheral loudspeakers. These data reveal that under attentional control, neural sound processing in spatial domain is more fine-tuned in conductors than, for example, in pianists, and, moreover, that sudden unexpected changes in spatial sound arrangement more readily catch their attention.

16.5.1.2 Evidence from brain anatomy

The difference between the neurocognitive processes of musicians and non-musicians can also be seen in the relative volume of their brain structures. This may be a result of the growth and differentiation of neural fibres (neurogenesis) and synapses (synaptogenesis), which mostly occurs during the prenatal period and early childhood (Kandel, Schwartz, & Jessel, 2000), and is thus especially evident in musicians who start early to play. Alternatively, the observed differences between musically expert and non-expert subjects may result from innate larger neuronal population and connections functionally necessary to music processing in individuals who will later show interest in musical creative activity.

This question is of central importance when discussing creativity in music, especially if as a creative musician we mean the "genius", i.e., an individual who excels in music production beyond his or her contemporaries and beyond the capabilities provided by his or her expertise (cf. Sloboda, 1996). For instance, neurologists have compared brain volumes *post mortem*, reporting enlarged auditory areas in famous composers (see Meyer, 1977).

Currently, anatomical comparisons may be performed in living musicians as well. One of the brain structures that have been found to be larger in volume in musicians as compared to non-musicians is the corpus callosum, the neural fibre tract transferring information between the left and right hemispheres (Schlaug, Jäncke, Huang, Staiger, & Steinmetz, 1995). Even the cerebellum was found larger in volume in male musicians as compared to male non-musicians (Schlaug, 2001). Female musicians did not show any difference in the cerebellum size as compared to their non-musician counterparts, possibly due to the earlier development of the cerebellum in female than male individuals. Rather, female musicians tended to have a larger brain volume, possibly due to other regions outside the cerebellum showing structural plasticity.

Additionally, by using a marker of the motor cortex (the intrasulcal length of the posterior bank of the precentral gyrus, ILPG), it was demonstrated that musicians have a greater symmetry in that region between left and right hemispheres as compared to non-musicians, resulting from the larger volume

of the ILPG controlling the non-dominant hand (Amunts, Schlaug, Jäncke, Dabringhaus, Schleicher, & Zilles, 1997). Another result of this study was that musicians present a larger motor cortex than non-musicians in both the left and right hemispheres. Interestingly, the increased volume of the left and right motor cortices in musicians strongly correlated with the age of commencement of musical education, favouring a plasticity- rather than talent-oriented explanation of the results.

Further research conducted with more advanced morphometric techniques showed that professional musicians have higher grey matter concentration than non-musicians in several brain structures: the perirolandic region; the premotor region; the posterior superior parietal region; the posterior mesial perisylvian region; and the cerebellum (Gaser & Schlaug, 2001). This study demonstrates that besides the augmented motor cortex, auditory areas, and cerebellum, found in previous studies, the posterior superior parietal region also differentiates expert from non-expert subjects. However, as mentioned above, that region is crucial for music performance, being the locus of symbol-to-sound integration and motor planning in the brain (Sergent *et al.*, 1992; Schön *et al.*, 2002).

We may conclude that musical expertise as a multimodal cognitive and emotional entity can be investigated using multiple experimental settings by structural or functional measures. Several empirical findings underline the importance of early musical exposure and thus of training (Amunts *et al.*, 1997; Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995; Pantev *et al.*, 1998; Takeuchi & Hulse, 1993) in the development of musical skills and related neural networks. However, it currently remains unknown whether musical expertise and concomitant patterns of neural functions result from intensive training alone or rely mainly on innate properties. In the next section, we describe experiments that explore this topic.

16.5.2 Musical vs. *non-musical individuals*

To be creative and proficient in music listening, expertise and motoric skills are needed. In particular, the findings described above show that the neurophysiological responses to sounds occurring 100 ms after the sound onset are enhanced in musicians as compared to non-musicians. Therefore, for studying the musical faculty, we would need to gather empirical data in longitudinal, well-controlled conditions in order to disentangle the differential roles of acquired skills and of (probably innate) creative abilities. Unfortunately, by their nature, these studies cannot easily separate the role of a musical family environment (often encountered as the background of children who had music lessons at an early age) and that of innate abilities.

Another approach to the scientific investigation on the nature *vs.* nurture topic in music is to look at the neurophysiological and anatomical correlates of musical aptitude or musicality. In the first theoretical definitions, musicality has been regarded as a sensory ability consisting of, for example,

discriminating slightly different pitches or timbres (Seashore, 1938). Others have defined it as the ability to notice the holistic properties of music, such as its meaning or aesthetic qualities (Wing, 1948). More recent views point to cognitive factors underlying musicality, such as the ability to structure the ongoing flow of musical information (Karma, 1994). Also, other views have emerged, e.g., emphasizing the hereditability of individual differences in pitch discrimination skills (Drayna, Manichaikul, de Lange, Snieder, & Spector, 2001).

A recent study compared the processing of amplitude-modulated sinusoidal tones in the primary auditory cortex of non-musicians, professional musicians, and amateurs (Schneider, Scherg, Dosch, Specht, Gutschalk, & Rupp, 2002). Results showed that, compared with non-musicians, professional musicians had magnetic brain responses about 100 per cent greater after 19–30 ms from stimulus onset. Moreover, MRI-based volumetry showed that the grey matter volume of the anteromedial Heschl's gyrus in professional musicians was 1.3 times the size of that in non-musicians (Figure 16.2). These results confirm and generalize previous findings pointing to enhanced cortical representations of familiar timbres in musicians (Pantev *et al.*, 1998, 2001). Furthermore, most interestingly, both measures were highly correlated with the results of a musical aptitude test.[5] This suggests that both the morphology and the neurophysiology of the Heschl's gyrus are essential for musical aptitude. Moreover, the authors claimed that the increased volume of the auditory cortex in musicians cannot be fully explained by training but must include a substantial genetic component.

A follow-up study by the same group of scientists measured the later magnetic responses to the same amplitude-modulated sine tones occurring at about 50 ms after sound onset, known to originate in the auditory cortex laterally to the primarily evoked magnetic responses (Schneider, Scherg, Dosch, Specht, & Rupp, 2003). Again, in this analysis, musicians presented much larger cortical responses than non-musicians. However, the strength of the responses correlated with the amount of musical training in the previous ten years of practice and did not differentiate amateurs from naïve subjects, leading only to a weak correlation to musical aptitude. Consequently, Schneider *et al.* (2003) suggested that the earlier magnetic responses to sounds reflect the level of musical aptitude, whereas the later magnetic responses (also found by Pantev *et al.*, 1998, 2001; Shahin *et al.*, 2003) demonstrate long-term plasticity of the auditory cortex stemming from musical training.

Studies have also been conducted at the level of short-term (sensory) memory for sounds. The first evidence was obtained by Lang, Nyrke, Ek, Aaltonen, Raimo, and Näätänen (1990), who used sensory level conceptualization of musical aptitude (as offered by Seashore, 1938). They tested, first, the musicality scores of a large group of high-school students by using Seashore's (1938) pitch-discrimination test. Thereafter, the students participated in an MMN recording, in which their accuracy in automatically

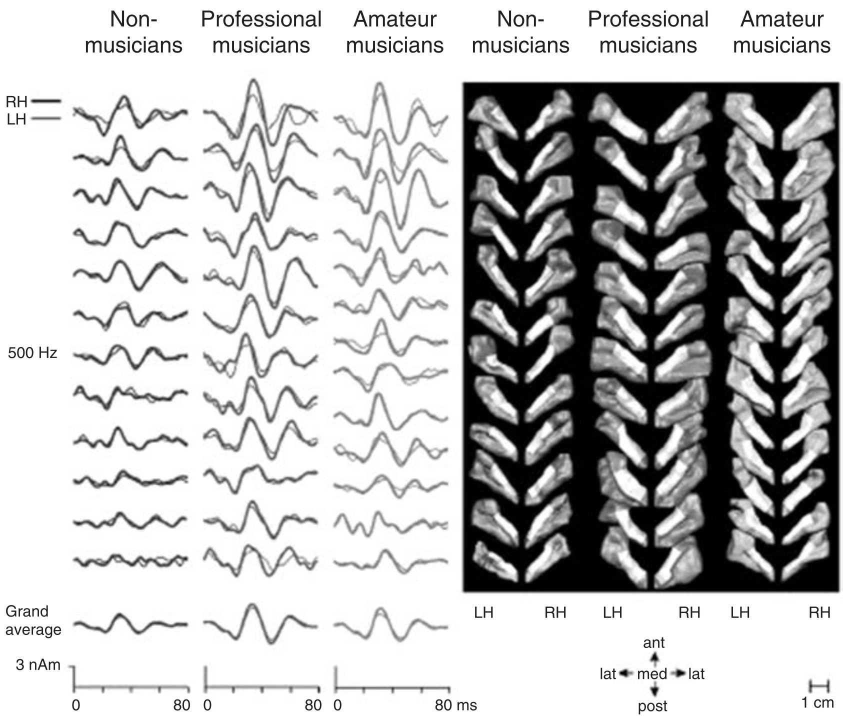

Figure 16.2 (Left) Individual and grouped auditory evoked magnetic signals (N19m and P30m) in response to amplitude modulated tones with a carrier frequency of 500 Hz. The waveforms show the activity over time of the source modelled as a current dipole. (Right) 3D grey matter reconstruction of the Heschl's gyrus for all subjects aligned in the same way. The neurophysiological and volumetric data demonstrate enhanced magnetic evoked responses and grey matter volume of the primary auditory cortex in professional musicians. Reproduced with permission from Schneider *et al.* (2002).

detecting pitch changes was determined. They were divided into three groups on the basis of their musicality test score. While the pitch MMN could be observed in the best performers with just 19 Hz frequency change, over 50 Hz change was necessary in the poor performers group for MMN elicitation, at the frequency range of 700 Hz.

A complementary approach is given by Tervaniemi, Ilvonen, Karma, Alho, and Näätänen (1997), who conceptualized musicality as the ability to structure the ongoing auditory material into meaningful entities. They found that good scores in such a cognitively oriented musicality test (Karma, 1994) were mirrored at the neural index of sensory memory. More specifically, when subjects were given sound stimulation resembling that in the musicality test (sequences consisting of short tones continuously presented,

such as EFGAEFGAEFGA, infrequently interrupted by sequences in which the order of tones was changed, such as EFGAEGFAEFGA), the brain responses of musically talented subjects, according to results of the musicality test, were larger than those of non-musical subjects. In contrast, when sound stimulation included sound features not relevant in the musicality test (C major chord infrequently changed to C minor chord), the brain responses did not differentiate the groups. Since the subject groups were formed on the basis of musicality test score (there being no major difference in the musical training the subjects had received), one can conclude that the accuracy of the short-term memory system in the auditory cortex is one of the determinants of musicality *per se*.

It is obvious that the findings in the papers reviewed above are highly dependent on how the concept of musicality is specified and determined. Indeed, it seems that each of the views underlying musicality tests has some validity and that only by using them jointly could one obtain a more complete picture of the individual musical skills. Additionally, other tests should be designed in order to study aspects that may be as important in the development of musical skills and talents as, if not more important than, the perceptual and motor abilities investigated by the musicality tests mentioned above. Recent directions in neuroscience and psychology research point to the importance of other aspects of intelligence for success in a cognitive performance, such as personality and empathy (Damasio, 1995; Goleman, 1995). Moreover, musicians are used to conveying expression and emotion while performing. Consequently, the neural bases of these aspects of their creative production should also be investigated in the future.

16.5.3 Amusics

Recent data on so-called congenital amusics (Ayotte, Peretz, & Hyde, 2002; Peretz, Ayotte, Zatorre, Mehler, Ahad, Penhune, *et al.*, 2002) indirectly support the hypothesis that auditory skills are crucial for the appreciation of music and for the development of creative skills in musicians. In these special subjects, impaired auditory skills seem to undermine the possibility of creative music listening, in the sense of appreciation and identification of musical pieces. Of the 11 subjects tested by Ayotte, Peretz, and Hyde (2002), seven reported not appreciating music and two subjects even said that they found music unpleasant and that, consequently, they actively tried to avoid it. In the study, amusics interpreted speech intonation correctly, and identified and recognized sounds of the environment. Consequently, these achievements in the auditory domain contrast with the poor level of performance in recognizing and memorizing musical sequences, leading the authors to define the disorder as music-specific. Their explanation of the music disorder was related to developmental deficits in pitch discrimination: “The ensemble of musical deficits are cascade effects of a faulty pitch processing system, i.e., fine-grained pitch perception might be an essential component around

which the musical system develops in a normal brain" (Ayotte *et al.*, 2002, p. 250).

Rhythmic difficulties have been also observed in amusic subjects, such as in discriminating temporal changes within melodies (Hyde & Peretz, 2004) or in tapping in time with the music (Dalla Bella & Peretz, 2003). These findings seem to base the congenital amusia syndrome on a general disturbance of auditory perception involving both pitch and temporal domains. However, amusics could tap in time with noise bursts, if not with music (Dalla Bella & Peretz, 2003), and could discriminate fine temporal but not pitch deviations in monotone sequences (Hyde & Peretz, 2004). This suggests that amusics' impairment may result from a cascade effect of a faulty pitch-processing system, leading to a disorder in music perception and preventing them from extracting musical scales or even a musical beat.

16.5.4 Creative **vs.** *less creative music performers*

Creativity in musical performance is conspicuously evident in improvisation. The greater part by far of musical improvisation is an explicitly social activity, where performers creatively interact and communicate with each other and with the audience. Since neuroscience mainly focuses on the neural bases of behaviour and cognitive functions in the single individual, it has so far devoted little attention to the social aspects of musical improvisation.

Although no study has specifically measured brain activation during improvisation, interesting research has highlighted differences in neural sound processing between musicians able to use improvisational strategies and other musicians. In particular, results showed that the auditory cortex of musicians who prefer to play without a score has superior abilities to discriminate small pitch deviations in transposed patterns (Tervaniemi *et al.*, 2001), or, in other words, it exhibits faster and more accurate memory traces for the pitch contour of complex tonal patterns (Figure 16.3). This suggests that the long-term practice of playing without a score, for example, during jazz improvisation, has plastically modified the neural circuits to improve performance and facilitate automatic extraction and recognition of musical patterns (an auditory skill that is assumed to represent a factor in improvisation or proficient sight-reading skills). This would enable the performers to form the image of the pattern to be played more quickly in their auditory mind. Alternatively, as briefly discussed above, this auditory ability might be a prerequisite for childhood development of a talent for improvisation. These hypotheses need to be tested by future experiments. It is even sometimes claimed that improvisational skills are very diffuse in children and are lost as a result of learning and formal training in playing an instrument. In order to avoid this drawback, certain educational methods (e.g., the Suzuki method) use and train improvisational skills to emotionally involve and motivate the very young music student and to teach the basics of music practice.

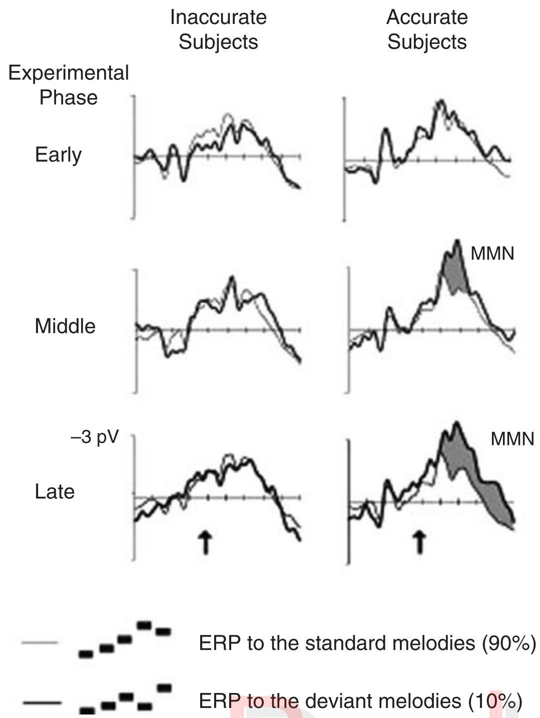

Figure 16.3 The electric brain responses recorded during presentation of transposed melodies. The subjects were divided into two groups on the basis of their accuracy in differentiating two kinds of melodies from each other. In subjects who detected less than 50 per cent of the deviant melody patterns (left, five musicians, seven non-musicians), no sound-change related response (MMN) was elicited. In subjects who detected 90 per cent of the deviant melodies (right, eight musicians, all performing music without a score) an MMN was elicited. These data suggest that musical training facilitates but does not guarantee learning to discriminate highly complex musical material. Reproduced with permission from Tervaniemi *et al.* (2001).

16.6 Discussion

In the present chapter we have described findings that may help to clarify the difficult issue of the biological bases of creativity in music. In particular, we have reviewed studies that search for any evidence of musical talent in the brain by comparing musicians with non-musicians. We have also emphasized that, in studying neurophysiological differences between musicians and non-musicians, we may encounter the risk of confounding effects of expertise, causing cortical plasticity, with actual neural correlates of precocious talent for music. This problem exists to a minor degree for other

domains of creativity as well (for example, when studying professional painters against untalented amateurs), in which effects of training on cortical plasticity are less empirically evident (see, however, Neitz, Carroll, Yamauchi, Neitz, & Williams, 2002 for pioneering work on colour plasticity in adults).

In general, in music the sensorial aspects are more salient than the conceptual ones. In the words of the nineteenth-century German physiologist Hermann von Helmholtz (1954, p. 3):

> In music, the sensations of tone are the material of the art . . . When in hearing a concert we recognize one tone as due to a violin and another to a clarinet, our artistic enjoyment does not depend upon our conception of a violin or clarinet, but solely on our hearing of the tones they produce, whereas the artistic enjoyment resulting from viewing a marble statue does not depend on the white light which it reflects into the eye, but upon the mental image of the beautiful human form which it calls up. In this sense it is clear that music has a more immediate connection with pure sensation than any other of the fine arts, and, consequently, that the theory of the sensations of hearing is destined to play a much more important part in musical aesthetics, than, for example, the theory of *chiaroscuro* or of perspective in painting.

From the findings reviewed here, we can tentatively propose a few working hypotheses. First, the differences in brain activation between musicians and non-musicians or between musical and non-musical subjects (that is, those not having a formal training in music) may indicate that some aspects of musical creativity lie in the enhanced cortical responses to sound in musicians, especially when those sounds are musically relevant or familiar (Besson & Faita, 1995; Besson *et al.*, 1994; Pantev *et al.*, 1998, 2001; Schneider *et al.*, 2002; Shahin *et al.*, 2003). However, this may simply be a result of training and expertise. One of the strongest pieces of evidence favouring the importance of the efficiency of the auditory cortex for the development of creative skills in music comes from the study by Tervaniemi *et al.* (2001). They showed that only the brains of those musicians who were improvisers reacted to contour variations within temporally complex patterns.

The data pointing to the increased level of cortical responses to sounds in musicians seem partially to contradict some empirical theories about creativity, especially when we assume a correlation between cortical ongoing electrophysiological signal, body state, and averaged responses to sounds (Hull, 1943; Mednick, 1962). Previously, it has been proposed that increases in cortical reactivity (arousal) render behaviour more stereotypical whereas decreases in arousal make behaviour more variable, and thus more creative. Empirical research has also demonstrated that more creative subjects as compared to less creative (as assessed by paper and pencil tests measuring

level of creativity) show more spontaneous galvanic skin response fluctuations, greater heart rate variability, and more variability in the EEG alpha amplitude (see Martindale, 1999 for a review). Moreover, in an EEG study (Martindale & Hines, 1975) in which subjects were engaged in completing a test of creativity, of creativity and intelligence, and of intelligence alone, the most creative subjects showed the lowest arousal (measured as higher amplitude in alpha-wave activity) while taking the creative test and the highest in the intelligence test. On the other hand, less creative subjects had similar arousal while taking each of the tests. From these data we might expect that musicians, especially composers, would have the lowest arousal. This hypothesis has not been directly tested: in studies reviewed above, only averaged responses to sounds or coherent activations were measured. Consequently, future experiments are needed to respond to the question posed.

In general, though, the data reviewed above indicate that neural facilitation in sound processing may play an essential role in musical creativity. In particular, the abilities of neural populations to process temporally complex sounds and to discriminate small pitch changes seem to be the starting point for developing the cognitive skills needed to interpret and appreciate music. We have reviewed studies showing how individuals with musical aptitude have increased grey matter volume in the primary auditory cortex and how this facilitates the neurophysiological responses to simple sounds (Schneider *et al.*, 2002) and also to complex sounds (Tervaniemi *et al.*, 1997).

The lateralization of brain activation in the right hemisphere during listening or performance of music may lead us to suppose that this hemisphere, considered as the site of spatial, non-verbal, holistic processing, has a privileged role for musical creativity. However, contradictory evidence has been found when comparing musicians and non-musicians. For example, in some studies the musicians' brain responses while listening to music were lateralized to the left (Bever & Chiarello, 1974; Bhattacharya & Petsche, 2001). However, other experiments reported contrasting evidence (Gaab & Schlaug, 2003; Gaede, Parsons, & Bertera, 1978; Zatorre, 1979). This again shows the difficulty of investigating such a subject as creativity in music, since in this art the neural correlates of perception are plastically affected and modified by extensive training. However, as a concluding remark, we may affirm that musical creativity is a multimodal and crossmodal human function with neurological bases that are widely distributed in both cerebral hemispheres, in frontal, temporal, and parietal areas.

Acknowledgements

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Notes

1 Phrenology originated from the studies of the Viennese physician Franz Joseph Gall. He believed that by examining the shape and unevenness of a head or skull, one could discover the development of the particular cerebral organ responsible for different intellectual aptitudes and character traits.

2 EEG is the most suitable method of cognitive neuroscience for such a purpose since, first, it is possible to use a real musical instrument in the EEG chamber and, second, movement artefacts (caused by hand movements) can be compensated for off-line. In contrast, in fMRI or MEG no objects containing metal can be brought to the experimental chamber and, even if artificial instruments were used, movement artefacts would damage the data interpretations much more severely.

3 This is not to neglect the importance of the instrumental background of the conductors. However, it is unusual to remain active as a solo player in parallel with developing a career as a conductor.

4 The Nd component of the ERP indexes the amount of neural activation related to attentional as compared to non-attentional listening.

5 The musicality test used was the AMMA tonal test, which measures the pitch discrimination abilities of individuals. It presents 30 pairs of short melodies. The second melody of the pair may be the same as the first one, or may contain a small change in pitch or rhythm. Subjects are asked to detect the modification in a three-way forced choice task.

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17 Beyond global and local theories of musical creativity

Looking for specific indicators of mental activity during music processing

Marta Olivetti Belardinelli

17.1 Introduction

The lack of a comprehensive definition of creativity and, as a consequence, of a shared model of musical creativity, as well as the difficulties caused by different neuroimaging techniques, when one attempts to underpin complex mental activities that are essentially intermodal and not task-dependent, make the choice among the following theories challenging: a *global theory* (according to which musical creativity is mediated by the same global neural state as in other forms of creativity); a *local theory* (according to which musical creativity is mediated by neural mechanisms tied to specific music regions in the brain); and an *intermediate theory* postulating global principles, applied to specific regions associated with music, when the approach is neuroscientific.

In fact, the evidence regarding a fixed arrangement of brain organization for music in humans remains elusive, in spite of the partial results regarding some of the mechanisms involved in music processing and the aptness of exploiting more recent brain imagery techniques.

This chapter will follow the opposite course, by starting from a cognitive model that inspired noteworthy behavioural research in order to establish a suitable basis for neuroscientific research aimed at detecting specific indicators of mental activity during creative music processing.

According to my systemic cognitive perspective, cognitive processing occurring during the composition, performance, and enjoyment of music is a mental process in which the discrepancies created by incoming stimuli or information are reduced. In the frame of this dynamic model, all three modalities of music processing are considered to be equivalent. However, one may object that the composition of music differs from the other two processes, as only in the former case the discrepancy, i.e., the initial compositional idea that gave rise to processing, comes from within the cognitive system and is therefore of an inner nature.

In reality, in all cases, i.e., in composing, as in performing and listening to music, it is only the mental representation of the discrepancy information that is able to elicit processing, whether the stimulus be of an internal or

an external nature. As a consequence, the first problem to be tackled by means of neuropsychological investigations is the potential specificity of the musical representation, or perhaps even before that, the problem of acoustic imagination, with respect to imagination deriving from other sensory modalities.

When approaching this problem by means of functional magnetic resonance imaging (fMRI), we were able to demonstrate that the central representation is always a combined set of multimodal activations. As a consequence, the activity as a whole is subject to overall competition for access to attention and memory resources.

Indeed, the characteristics of perception, attention, and memory during musical processing have until now been only partially investigated. Our most recent results on these topics, investigated by means of behavioural and neuroimaging studies, are presented here.

17.2 Searching for a definition of human creativity

It is highly likely that the lack of a comprehensive definition of human creativity is the outcome of the mutual influence of a multiplicity of factors. At the beginning of experimental research on the topic, Guilford (1967) limited his battery of tests designed to assess creativity to measuring the fluency, flexibility, and originality of thought in the verbal and visual domains. Researchers' interests then spread from the analysis of established cognitive productions to the investigation of creative persons' biographies, and, later, from the stimulation of school-children's creativity to mathematical modelling and computer simulations of cognitive functioning during artistic creation and scientific invention. Thus, it became evident that creativity, as a recognized personal capability, has a twofold connection with the cultural context. The first is the cognitive domain, in which creative behaviour invents new rules and practices. The second is the establishment of cultural consensus on maintaining the innovation, due to its worthwhile and therefore creative nature. As regards the first point, it is evident that domain-specific peculiarities characterize the expressive modalities through which the creative production process develops. On the other hand, cultural consensus allows to survive only those innovations that do not completely disrupt the domain (Csikszentmihalyi, 1996). Stenberg (2000) holds that creativity is the courage to make decisions contrasting with current views, and to persuade people to accept them. On this basis, Stenberg, Gardner, and Simonton are pioneering the study of the relationships between creativity and leadership. Their work indicates that creative leadership is characterized not only by its psychological characteristics and domain-relative constraints, but also by the historical circumstances in which it unfolds (see Chamberlin, 2003, for the initial approach).

For the abovementioned reasons, creativity, as a complex systemic process, remains an elusive phenomenon to be investigated with the methods and procedures of experimental sciences. Furthermore, creative behaviour is

always the expression of a definite personal cognitive and affective style, which in turn is involved in multiphasic recursive processing. This kind of processing involves phases of preparation and insight, which are followed by evaluative and elaborative phases. All steps of the process are repeated when the creative product is evaluated as unsatisfactory.

17.2.1 Problems related to the definition of musical creativity

Difficulties of definition are particularly evident regarding musical creativity. The definition of what is creative in music is highly controversial and the lack of a shared model of musical creativity may be mainly attributed to three factors. The first is related to the peculiar nature of cognitive processing of music. The other two refer to cultural and technological changes.

The first reason is a direct consequence of the fact that music develops in time and must be processed sequentially. Therefore, in the case of music that combines traditional and consolidated compositional elements in a highly innovative way, recognition of the creativity of the whole pattern is generally a secondary process. That is, it may occur only on account of prior processing and maintenance in memory of the traditional compositional elements as they successively arrive.

Following the radical change in compositional rules from Schoenberg onwards, and attempts to disrupt the established tonal system, a second cause of difficulties in defining musical creativity emerged progressively in relation to the "nature/nurture" debate. That is to say: if music processing is grounded in an innate basis (as not only asserted by Chomskian musicology but also underpinned by empirical investigations within evolutionary cognitive science: see, for example, Wright, Rivera, Hulse, Shyan, & Neiworth, 2000, and, for a critical review, Hauser & McDermott, 2003), probably all attempts like Schoenberg's are rebellious rather than truly creative. On the other hand, Stenberg may define Stravinsky as an "advanced forward incrementor" for his radical use of rhythm in *The Rite of Spring*, as Stravinsky attempted to develop tonal music further than his contemporaries, but without discarding the tonal system.

Finally, the rapid progress of technological development that allowed the establishment and growth of new electronic music not only turned musical material and rules upside down, but also changed all figures and roles of "music workers". It has therefore become difficult to establish which figure is the performer and which is the composer, and to what degree each figure is responsible for creativity – not to mention the creativity of the listener attending an (often recorded) audio, audiovisual, or multimedia performance.

17.3 Neuropsychological questions about music processing

Definitional and conceptual issues are, however, only a part of the problem. The difficulties that different neuroimaging techniques encounter when

attempting to underpin complex mental activities, which are essentially intermodal and not task-dependent, make the general question about the neuroscientific foundations of musical creativity quite unapproachable, as a whole. The technical constraints characteristic of each type of neuroimaging technique make it impossible to choose a starting point among the various theoretical positions related to music processing in the brain architecture on the basis of the results obtained up to now.

Three different theoretical ways of approaching the main neuropsychological question may be adopted:

(1) *A global theory*, according to which music processing is mediated by the same global neural state as other forms of cognitive processing.
(2) *A local theory with global applications*, according to which musical representation is mediated by the same neural principles as other forms of mental representations. However, these principles are applied only to specific brain regions associated with music.
(3) *A local theory*, according to which musical representation is mediated by neural mechanisms that are specific to regions of the brain devoted to music processing, and is not related to mechanisms associated with cognitive processing in other domains.

In the opinion of many experts (Jonna Kwiatkowski, 2002, for example), none of these theoretical positions is supported by strong empirical evidence; nor is it possible to hold empirically supported critical discussions.

To choose among these three possibilities, one ought to have conclusive answers to the following questions:

(1) Are there neural networks that are exclusively dedicated to music, and, more specifically, to the composition of music, for those who consider this to be the only expression of musical creativity?
(2) How does brain specialization for music fit into the debates between instructivism and selectionism, modular processing and central processing, prewiring and functional plasticity?
(3) Is it possible that acquired processing modalities become modular and therefore functionally independent from other cognitive capacities?

In a recent essay on the biological foundations of music, Isabelle Peretz (2001) says that "the patient-based approach converges on the notion that music is subserved by neural networks that are dedicated to its processing." But somewhat later she is compelled to underline that "Although perfectly suited to the exploitation of the new brain imagery techniques, the demonstration" of a fixed arrangement of "brain organization for music in all humans remains elusive. The only consensus that has been reached today concerns only one component of the music-processing system: the pitch contour extraction mechanism" involving the superior temporal gyrus and frontal

regions on the right side of the brain (see Peretz, 2000 for a review). Although she is aware that "it remains to be determined if this processing component is music-specific, since the intonation patterns of speech seem to recruit similar if not identical brain circuitries" (Patel, Peretz, Tramo, & Labreque, 1998; Zatorre, Evans, Meyer, & Gjedde, 1992), she concludes by "proposing that the two anchorage points of brain specialization for music are the encoding of pitch along musical scales and the ascribing of a regular pulse to incoming events" (Peretz, 2001, p. 440). These anchorage points are represented as component modules in the modular functional architecture for music processing that Peretz and Coltheart (2003) have recently proposed as a plausible framework for further neuroscientifc investigation. Their work started from the study of neurological patients suffering from aphasia and congenital amusia (that is, from neurological disorders affecting the comprehension and/or production of language and music respectively).

The topic of anchorage points does not become any clearer when approached by means of neuroimaging techniques. For example, in 1999, Griffiths, Johnsrude, Dean, and Green supported "a common initial mechanism for the analysis of pitch and duration patterns within sequences" by means of positron emission tomography research (PET is a nuclear medicine technique which uses a radioactive tracer that combines with biological molecules in such a way as to emit gamma photons, which allows the distribution of radioactivity within the cerebral tissue to be detected). In 2001, Griffiths, Uppenkamp, Johnsrude, Josephs, and Patterson demonstrated a two-stage physiological mechanism in recording temporal patterns, "while no change in brainstem activity is observed when pitches change at rates common in music and speech". This study was carried out by means of an fMRI technique (fMRI is based on the hydrogen atom nucleus re-emitting a radio signal when it is irradiated within a magnetic field, and on the assumption that neural activity is correlated with the enhancement of oxygen availability, due to regional cerebral blood flow).

Without doubt, the cerebral processing of the temporal structure of sound (see Griffiths, Buchel, Frackowiak, & Patterson, 1998) is a recent issue that further complicates the problem stemming from the different temporal resolutions of the diverse neuroimaging techniques now available. Differences between structurally different cues have already emerged at the behavioural level. That is, periodic cues enhance time reproduction accuracy, while discontinuity in serial organization improves pulse-counting accuracy (Di Matteo, 2002). Moreover, temporal cues exert different constraints on speech and music (see Jungers, Palmer, & Speer, 2002 for a review) although these differences in constraints could be determined by differences in syntax. With regard to this, starting from the "contradiction between recent studies of syntax in language and music based on neuroimaging (which suggest overlap) and neuropsychology (which suggest dissociation)", Patel infers that "linguistic and musical syntax share certain syntactic processes (instantiated

in overlapping frontal brain areas) that apply over different domain-specific syntactic representations in posterior brain regions" (Patel, 2003, p. 679).

Regarding this predicament, Bob Snyder (2000) conveniently distinguishes three different time levels of musical experience:

(1) The *event fusion level* of musical experience. At this level repeating acoustical vibrations that occur closer together than 50 ms (= 20 events per second) fuse together to form *pitches*. This is the only time level in which the most basic events – individual acoustical vibrations – are *not* directly perceptible. Only the boundaries, not exceeding the length of echoic memory, between *single* events are detected. The lowest perceptible grouping at the event fusion level is a single *pitch event*.
(2) The *level of melodic and rhythmic grouping*. At this level temporally extended patterns consisting of *multiple* events are detected by means of short-term memory. Separate events on this timescale are grouped together in the *present*: in (a) *melodic grouping*, sequences of pitches are grouped according to their similarity of range, while in (b) *rhythmic grouping*, events are grouped according to their timing and intensity.
(3) The *level of form*. Large groupings of events, which exist on a timescale that requires long-term memory in order to reconstruct, discover and recollect relations between events.

"All of our experiences of these three levels are actually of temporal relationships. These different levels of experience are really just differences in our own modes of information processing and memory" (Snyder, 2000, p. 15).

17.4 A cognitive model based on discrepancy reduction

At this point it is therefore evident that a different approach is needed in order to ground the neuroscientific approach to music processing on an unequivocal basis.

As a first step towards clarifying the mental organization of musical experience, a new general model of organism–environment interactions is required. In this model the multimodal activation related to complex activities such as music processing can be examined in its components.

According to my holistic approach to psychology (Olivetti Belardinelli, 1986, 1993, 1998), cognitive information processing occurs within the organism–environment system, conceived as an indivisible whole. Therefore, at the level of living systems, the internal–external boundary is no longer simply given. Instead it serves to transmit information into the interior of the system in a way that reduces its entropy. It is, however, not possible to determine the nature of external reality any further, nor is it possible to guarantee a correspondence between the organization of imagination, i.e., the inner order of the system, and the order of the environment, from which each self-organizing system absorbs energy and order.

The organism and the environment (especially the social environment) are two subsystems. Both are intended for and directed towards the maintenance of intrasystem and intersystem constancy, in a way that is peculiar to and specific to, as well as economic for, each system. The dynamic equilibrium that is reached is absolutely unstable. This is because, within the flux of the equilibration processes, the structural and dynamic processes of the subsystem that takes the leading role in the interaction prevail time after time. In terms of architecture, the proposed model of the mind involves dual articulation in horizontal and vertical directions. The connections are distributed in parallel, but also hierarchically organized. Processing can take place simultaneously in the two directions: bottom-up and top-down.

This ensures spontaneous modification of modes of information processing as complexity increases.

The conceptual model also implies close connections between the hierarchical functional organization of mental activities and a corresponding organization existing in the cerebral structure. Our experiments in various domains tend to confirm the existence of modules characterized by an automatic type of functioning. This type of functioning leads to rapid perceptual recognition and is controlled by modules of a higher hierarchical level. These modules come into play only when the functioning of lower level modules gives rise to discrepancies between the expectations of the system and the external input. This hierarchical structure is embedded in a more general structure, the specific modality of functioning of the mental processes. This links the common hierarchical structure to "cognitive styles", personality traits, and attitudes towards problem situations. These factors correspond to states of dynamic equilibrium with the external environment and are regulated by specific "principles of the minimum" that establish the direction of ongoing processes through a feedforward process.

The feedforward can be seen as a proactive effect of the discrepancy information produced by the input. After a comparison with the organism's own levels of adaptation, the discrepancy information is projected into the future, in order to determine the point at which the discrepancy can be eliminated, and the behaviour will cease. The theoretical model description of the feedforward process has proved to be remarkably useful because it forces the researcher to attend to interactions among operations. These are especially relevant at the human cognitive level. Here non-eliminable interactions between operations reach extremely high degrees of complexity. This is due to the predominance of the semantic character of information in all intrasystemic and intersystemic processes.

17.5 The mental representation of music and its neuropsychological investigation

The prevalence of the semantic level of information is particularly evident in music processing. It may be considered a decisive factor in all types of music

processing, that is, in composing, performing, and listening to music. Within the framework of the abovementioned dynamic model, all three modalities of music processing are equivalent. Music processing may be described as a mental process in which the discrepancies created by incoming stimuli or information are reduced. One can object that the case of musical composition is different from the others: only in this case does the discrepancy, i.e., the first compositional idea that gives rise to the processing, come from within the cognitive system; it is therefore of an inner nature. In reality, this is also always the case in performance and in listening to music. It is only the mental representation of the discrepancy information that can elicit the processing, whether the stimulus be of an internal or external nature.

Mental representation may be identified in what Taylor (1996, 2001) calls the *central representation*, meaning "the combined set of multimodal activations involved in fusing sensory activity, body positions, salience and intentionality". In order to integrate the multimodal activations in a central representation, the whole activity must compete for access to the attention and memory resources (Posner, Walker, Friedrich, & Rafal, 1987). Indeed, the characteristics of perception, attention, and memory that, through the competition process, contribute to determining the mental representation during musical processing have, up to now, been only partially investigated. However, while framing music processing in a general model of organism–environment interactions, it became evident to us that the first problem to be tackled, by means of neuropsychological investigations, is the eventual specificity of the musical representation, and perhaps, even earlier, of acoustic imagination with respect to imagination deriving from other sensory modalities.

17.5.1 Testing the multimodality of the central representation

To unravel an intricate question such as the multimodal organization of the central representation, an fMRI study was performed in collaboration with the research team of the Department of Clinical Sciences and Biomedical Imaging (directed by Gianluca Romani) of the University of Chieti. The aim was to identify similarities and differences of visual images and images generated according to other sensory modalities, and subsequently their common substrate (Olivetti Belardinelli, Di Matteo, Del Gratta, De Nicola, Ferretti, & Romani, 2004a; Olivetti Belardinelli, Di Matteo, Del Gratta, De Nicola, Ferretti, Tartaro *et al.*, 2004b). The experimental task required subjects to generate mental images cued by short sentences describing different perceptual objects (shapes, sounds, odours, flavours, self-perceived movements, and internal sensations). These were contrasted with sentences describing abstract concepts. Results showed that every type of mental imagination exhibits a different degree of overlap with visual imagination. In general, visual imagination mainly activates the right hemisphere. In contrast, tactile, olfactory, and gustatory imagination elicits predominantly left activation.

Auditory, kinaesthetic, and organic imagination elicit both hemispheres equally. Common activated areas were found in the middle-inferior temporal regions, especially in the left hemisphere, in the parietal associative region, and in the prefrontal regions. The results indicate either the involvement of amodal functional circuits of mental imagination or the presence of a visual imagination component in different types of mental images.

As regards the focus of this chapter, these results seems to confirm Taylor's statements about the multimodality of the activation in central representations. With respect to our model the results suggest that in mental processes different cross-modal possibilities exist to restore the discrepancies created by incoming stimuli or information.

17.5.2 Event-related potential (ERP) evidence concerning personal factors influencing sound localization

Evidence of the importance of individual cognitive styles in shaping acoustic mental representations emerged in the frame of our researches aimed at assessing the cerebral structures involved in sound localization (Brunetti, Belardinelli, Caulo, Del Gratta, Della Penna, Ferretti, *et al.*, 2005; Brunetti, Olivetti Belardinelli, Del Gratta, Pizzella, Belardinelli, Ferretti, *et al.*, 2003; Brunetti, Olivetti Belardinelli, Del Gratta, Pizzella, & Romani, 2002; Lucci, Pani, De Angelis, Belardinelli, Olivetti Belardinelli, & Gentilomo, 2003). In these studies, we used different neuroimaging techniques (besides fMRI, magnetoencephalography [MEG], a non-invasive technique measuring the weak magnetic fields produced by neuronal electrical activity, with a better spatial resolution than other imaging techniques; and ERPs, measuring the electrical activity recorded during task performance). In particular, by using ERPs, evidence was obtained suggesting that the cortical treatment of sound location is related to subjects' spontaneous rhythm (Olivetti Belardinelli *et al.*, 2003). Further, subjects with a spontaneous binary rhythm showed a mismatch negativity (MMN) in the frontal and right temporal regions for stimuli coming from 90° and deviant from 50° either on the right or on the left side, with respect to the frontal plane. In contrast, in subjects with a spontaneous ternary rhythm, MMN was elicited only in a central condition (with standard stimuli 20° to the right and deviant 20° left-sided) on the left-hand side in the frontal region and in both temporal ones (Olivetti Belardinelli, Lucci, De Angelis, Belardinelli, & Gentilomo, 2004c). These results underline the influence of spontaneous rhythms defined as internal stable states that modulate the incoming information. In this way, the internal states fashion mental representations according to personal cognitive style.

17.6 Searching for the anchor points of music processing

Apart from sensory representations, other factors such as the timbre and salience of the input, competitive attention, memory encoding, music training

and mental imagery ability in subjects are indicated in neuroimaging literature as important features of the central representation (see Samson, 2003, for a neuropsychological review on timbre perception; for theoretical considerations on the abovementioned single factors see Aleman, Nieuwenstein, Boecker, & de Haan, 2000; Izquierda, Quillfield, Zanatta, Quevedo, Schaeffer, Schmitz, *et al.*, 1997; Mesulam, 1985).

Strangely, while the very frequently evoked concept of salience is scarcely and then not unequivocally defined in the literature, the problem of memory for music is randomly tackled with respect to different styles and genres. This lack of contextualization has prevented researchers from reaching definite conclusions.

It can hardly be denied that, due to the peculiar characteristics of music processing, the topics of salience and memory are strictly interconnected. This connection places severe constraints on music processing, as salience and memory modulate the access to attentional resources.

The musical message, like every purely auditory message, is processed sequentially in time. Further, the decoding of musical meaning entails that what is heard sequentially in time is kept in memory in order to perform the message comprehension. In this way, temporal and metrical structures are built up through listening to the perceived characteristics that determine what in the central representation is heard as salient.

Considering the shared experience of tonal music in Western culture, Lerdahl and Jackendoff (1983) indicated tonality as the most powerful means for memory anchorage during music processing. On this basis, however, it is impossible to understand how and by which means one can listen to and comprehend music with which one is not acquainted, and whose grammar is therefore unknown, such as the music of other cultural traditions or even contemporary atonal music.

For this reason some authors (e.g., Deliège, 1989, 1993, 1996; Imberty, 1991; Lerdahl, 1989) tried to enquire into what could aid memory while listening to atonal music.

According to some studies (Butler, 1990; Imberty, 1999), during listening, subjects develop a temporary, perceptual and context-relative hierarchy of tensions. This hierarchy is continuously revised during listening. In this way temporal and metrical structures are built up through listening. As a consequence, psychology becomes mainly interested in assessing the cognitive rules according to which perceived characteristics determine what is heard as salient, within this new temporal scheme. The scheme is built by means of the decomposition of objective linear time, which may be conceived as an example of what Elman (1990) called an implicit representation of time. This representation brings us back to the problem of temporal encoding in the auditory and other body systems, to the temporal properties of neurons and the temporal encoding at the cortical level, and finally to the problem of decoding temporal information (Fotheringhame & Young, 1997).

17.6.1 Subjective states of awareness in music recognition

In order to grasp the meaning of a musical message, a listener has to continuously revise these provisional hierarchies while listening continues. Some anchor points for the listener's memory therefore need to be rapidly found. Apart from tonality, *salience* could afford an anchorage to memory. For the purpose of our research, salience is operationally defined as *the redundancy of rhythmic and melodic parameters*, emphasizing that only perceived characteristics have a precise function in structuring auditory time.

The underlining of the listener's modalities of perception leads us back to the subjective state of awareness that deeply influences recognition memory (Tulving, 1985). Based on Tulving's model, two memory systems may be involved in musical processing: semantic memory, characterized by a *noetic* state of awareness, which allows recognition by means of generalizations; and episodic memory, which contains mnestic traces of events tied to the subject's personal experience and is therefore characterized by *autonoetic* awareness. Recognition deriving from episodic memory is heavily influenced by perceptual factors (Rajaram, 1996). Episodic memory may be assessed by means of *Remember* responses (R). These are recollections of subjects' past experiences. On the contrary, recognition stemming from semantic memory is influenced by higher cognitive processes, such as conceptual learning and relational encoding. During recognition these memories are assessed by means of *Know* responses (K), indicating an impression of familiarity. Tulving's paradigm was previously used with musical material to verify his hypothesis on the complete independence of the two memory systems (Gardiner, Kaminska, Dixon, & Java, 1996; Java, Kaminska, & Gardiner, 1995).

17.6.2 Relevance of perceived characteristics in the recognition of different musical genres

We adopted Tulving's paradigm, with the general aim of assessing the relationship between salience and memory encoding and of ascertaining the perceived characteristics that contribute to building up the subjective temporal scheme underlying music processing. According to our general research plan, the neuroimaging research phase is based on a previous consistent behavioural investigation aimed at defining the effectiveness and relevance of the perceived characteritics in memory encoding. The behavioural research phase was therefore devoted to investigating the relative preeminence of tonality and salience as perceived stimulus characteristics, in forming the provisional hierarchy of auditory events that allows musical meaning to be grasped. In order to control for the stimulus structure, two series of 48 short musical themes were independently composed by two musicians (F. Cifariello Ciardi and F. Caltagirone). Each composer was asked to cover the two categories of salience (defined as above) and tonality, while controlling for timbre, the mean number of notes, mean duration, dynamics and

articulation. Therefore in each series four categories of musical themes (consisting of 12 stimuli each) were obtained: (1) salient–tonal pieces (ST), similar to Western popular music, especially of the late Baroque period; (2) non-salient–tonal pieces (NsT), similar to late Romantic music and contemporary applied music; (3) non-salient–non-tonal (NsNt) pieces, similar to dodecaphonic and serial music; (4) salient–non-tonal (SNt) pieces, similar to most recent popular music. The two series of stimuli were administered independently and randomly mixed according to a split-half technique to different subject groups. The order of presentation was counterbalanced within each trial.

In the behavioural studies, three groups of subjects were tested (200 subjects each): children, adults with no formal music training, and professional musicians. The 48 stimuli were split into a study list and a test list. During the study list phase, adults listened to only 24 excerpts out of 48 (six stimuli for each of the four categories). Because children have a more limited attention span, they were seen twice: each time, 24 stimuli were used and only 12 of them were inserted in the study list. In the test phase, in which the complete series of stimuli was presented, subjects were requested to identify the themes they had heard in the previous phase by means of R or K responses.

Subjects' answers were divided into three categories: R, K and "don't remember" responses (each subdivided into correct and wrong responses) and an ANOVA was performed considering all 600 subjects. A summary of results is shown in Figures 17.1, 17.2, and 17.3.

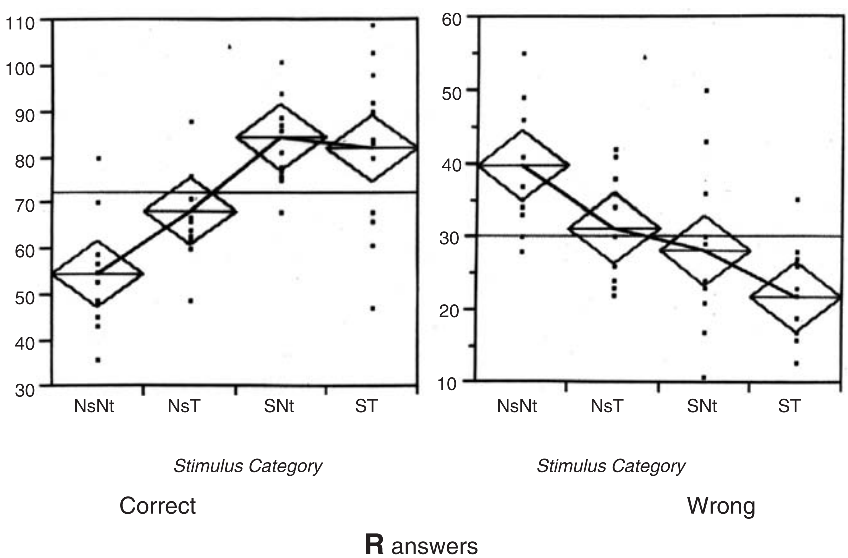

Figure 17.1 Frequences of correct and wrong "Remember" responses (recollection) separated for stimulus genre (Non-salient–Non-tonal; Non-salient–Tonal; Salient–Non-tonal; Salient–Tonal).

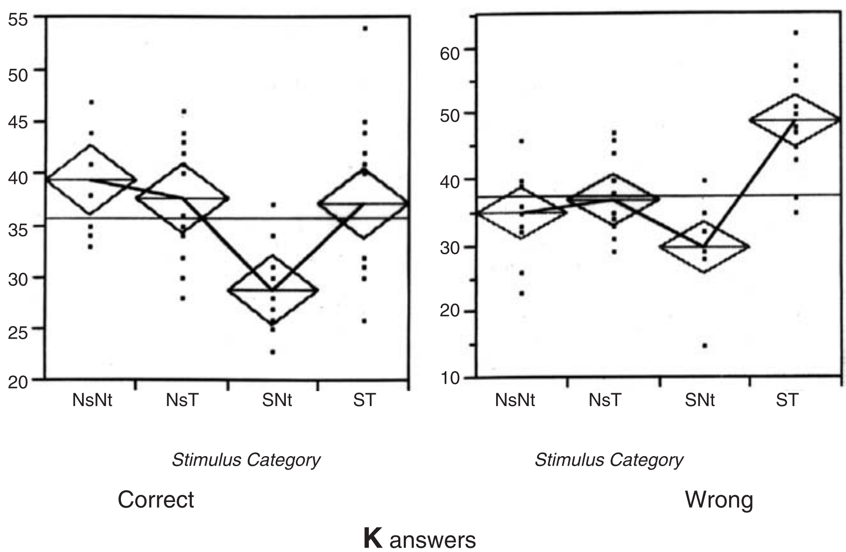

Figure 17.2 Frequences of correct and wrong "Know" responses (familiarity) separated for stimulus genre (Non-salient–Non-tonal; Non-salient–Tonal; Salient–Non-tonal; Salient–Tonal).

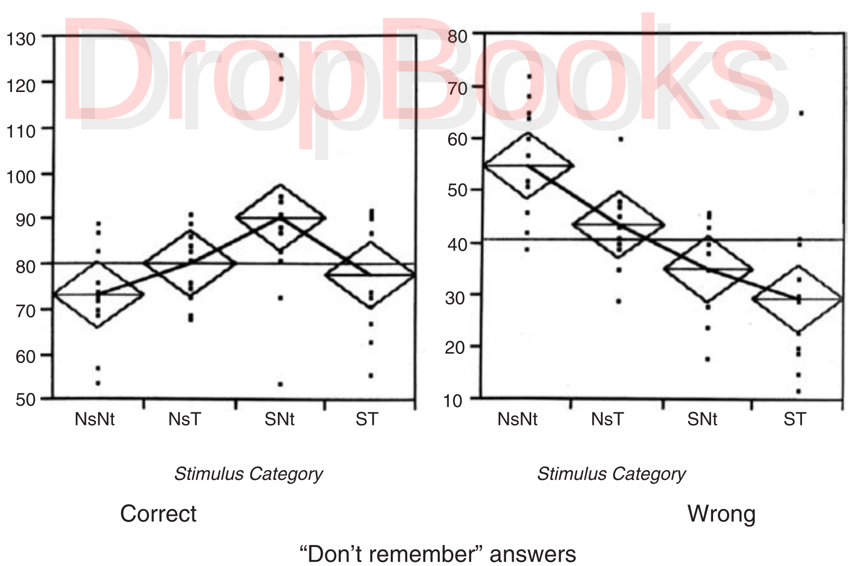

Figure 17.3 Frequences of correct and wrong "Don't remember" responses (non-recognition) separated for stimulus genre (Non-salient–Non-tonal; Non-salient–Tonal; Salient–Non-tonal; Salient–Tonal).

Subsequently, the probability of correct answers and of false alarms, for each stimulus category, was calculated according to signal detection theory on the same sample. By means of these indices, two cluster analyses were performed, on the basis firstly of tonality and then of salience. While the dendrogram by tonality did not show significant differences, clustering according to salience gave two separate clusters, corresponding highly to salient stimuli on the one hand and to non-salient stimuli on the other (see Figure 17.4).

To summarize our behavioural results regarding the stimulus structure, it consistently emerged that salience affords anchorage for episodic memory. In contrast, tonality, tied to semantic memory, favours recognition by generalization. When both salience and tonality are absent, recognition memory decreases drastically. However, when both are present, the probability of making false generalizations from semantic memory increases. The cluster analysis indicates that salience is the relevant perceived dimension discriminating among recognition answers to unknown musical stimuli (Olivetti Belardinelli & Rossi Arnaud, 1999).

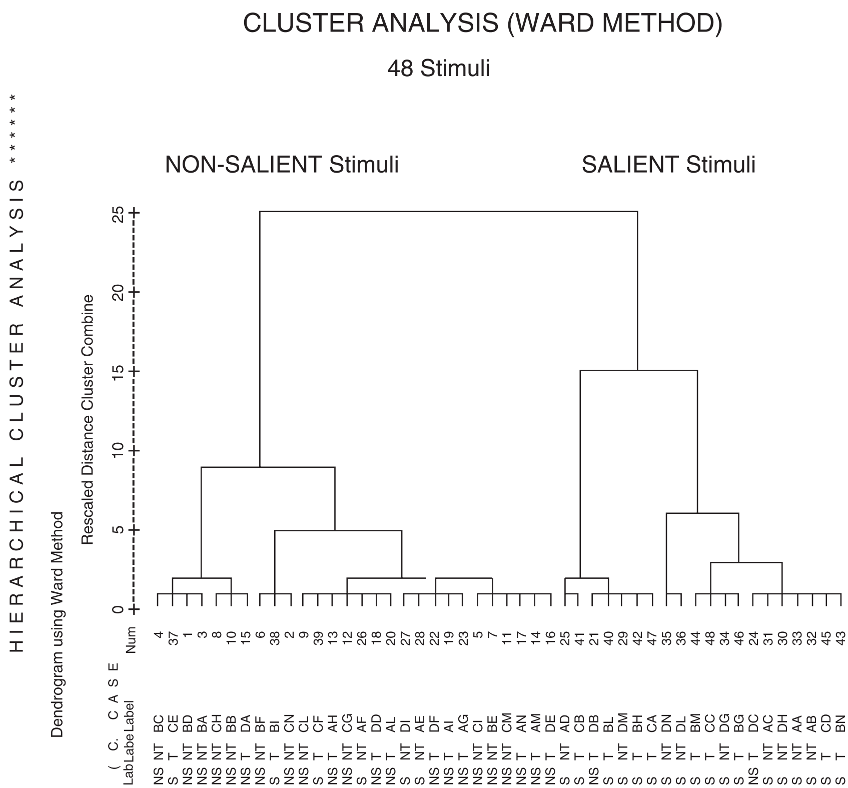

Figure 17.4 Dendogram by salience based on all subjects' answers (respectively from the lowest line below the dendogram: stimulus genre; stimulus label; stimulus number).

17.6.3 An fMRI investigation of the perception of salience and tonality

On the basis of these results, we decided to perform an fMRI investigation, aimed at assessing whether perception of salience determines different activation patterns from those determined by tonality. The first phase of this research (in progress) was performed in collaboration with an interdisciplinary team coordinated by Gian Luigi Lenzi at the Department of Neurology of the University of Rome "La Sapienza".

Sixteen right-handed, healthy volunteers (eight males and eight females aged 24–28), without any formal musical training, were asked to listen closely to 40 stimuli out of the two series of 48 created for the previous research. Twenty stimuli for each composer (five for each of the four categories) were chosen and presented in random order. Stimuli were administrated through earphones, while subjects had their eyes closed. Images were acquired with echo planar imaging (EPI) scans (at present the most rapid acquisition method in fMRI, as it reduces the occurrence of artefacts due to subject movement) in a 1.5T machine. The experimental session lasted about 15 minutes for each subject. Data were analysed with SPM99 (the most common software package for voxel-based analysis of neuroimaging data), modelling an epoch design in which stimuli were contrasted with the noise emitted by the scanner. Analysis consisted of three steps: pre-processing of data; statistical assessment; and localization of the activation loci. Statistical analysis was carried out as follows: first, the parameters of the specified model were estimated, correlating the intensity of the signal emitted by each voxel with the temporal course of the attended hemodynamic response. Then, a univariate t test was applied to each voxel separately in order to verify the null hypothesis.

Results from this analysis indicate that the processing of tonal stimuli selectively involved the anterior portion of the right inferior temporal gyrus and specific portions of the left superior and middle temporal gyri. Even though the inferior temporal gyrus is generally associated with the highest levels of visual processing in neuroimaging literature (Jagadeesh, Chelazzi, Mishkin, & Desimone, 2001; Li, Miller, & Desimone, 1993; Mishkin, Ungerleider, & Macko, 1983; Nobre, Allison, & McCarthy, 1994), some studies have found its involvement also in semantic auditory processing, i.e., in the recognition of words (Vandenberghe, Price, Wise, Josephs, & Frackowiak, 1996) and environmental sounds, and sensation of familiarity (Clarke, Bellmann Thiran, Maeder, Adriani, Vernet, Regli, *et al.*, 2002; Clarke, Bellmann, Meuli, Assal, & Steck, 2000; Giraud & Price, 2001) and visual–auditory integration. Also, according to the results of our previous behavioural research, these are all processes that may be conceived as directly implicated in the representation of tonal stimuli.

The processing of salient stimuli recruited less extensive cortical areas than those involved in the processing of non-salient stimuli. Furthermore, the

extension of the activation clusters in the different anatomical structures (temporal areas, precentral gyrus, etc.) tended to increase, as the complexity of the music increased from the lowest level ST category, to SNt, to NsT, to the most complex category of NsNt.

The cerebellum, a structure commonly associated with motor coordination, showed activity during the processing of the more confounding stimuli (ST, NsNt). These stimuli were characterized by the presence or absence of both "grammars" or anchorage systems, i.e., tonality and salience. This result is of particular importance considering that some recent studies have pointed out the role of the cerebellum in performing perceptual tasks, especially those involving rhythm processing (Brochard, Dufour, Drake, & Scheiber, 2000; Griffiths *et al.*, 1999; Parsons, 2001).

A separate analysis for genders was then performed, as gender differences in music processing had already been found with dichotic listening technique (see Olivetti Belardinelli and Sacchi, 1985, for a review). In recent decades, gender differences have been systematically investigated in numerous studies, adopting neuroimaging techniques with the aim of investigating several cognitive processes (Bengtsson, Berglund, Gulyas, Cohen, & Savic, 2001; Canli, Desmond, Zhao, & Gabrieli, 2002; Killgore & Yurgelun-Todd, 2001; Nyberg, Habib, & Herlitz, 2000; Speck, Ernst, Braun, Koch, Miller, & Chang, 2000; Thomsen, Hugdahl, Ersland, Barndon, Lundervold, Smievoll, *et al.*, 2000; Wrase, Klein, Gruesser, Hermann, Flor, Mann, *et al.*, 2003). Since the extensive literature on language has stimulated debates and provided evidence on the different neural bases between sexes (Baxter, Saykin, Flashman, Johnson, Guerin, Babcock, *et al.*, 2003; Coney, 2002; Kansaku, Yamamura, & Kitzawa, 2000; Schirmer, Kotz, & Friederici, 2002; Shaywitz, Shaywitz, Pugh, Constable, Skudlarski, Fulbright, *et al.*, 1995; Walla, Hufnagl, Lindinger, Deecke, & Lang, 2001), some recent work has also begun to consider sex as a relevant factor in the investigation of music processing (Boucher & Bryden, 1997; Evers, Dannert, Rodding, Rotter, & Ringelstein, 1999; Gaab, Keenan, & Schlaug, 2003; Hantz, Marvin, Kreilick, & Chapman, 1996; Koelsch, Grossmann, Gunter, Hahne, Schroger, & Friederici, 2003a; Koelsch, Maess, Grossmann, & Friederici, 2003b).

In our research, gender differences emerged at three levels: males and females exhibited different degrees of activation (more widespread in males than in females), different localization patterns (slightly greater to the left in males and to the right in females), and the recruitment of different specific cerebral structures (in particular, the precentral gyri – BA 6 – in males and supramarginal gyri – BA 40 – in females). As regards the precentral gyri, although these structures are generally associated with the control of movement (pre-motor areas), activation has been found in certain aspects of music processing, such as the direction of attention (Janata, Tillmann, & Bharucha, 2002), timbre processing (Platel, Price, Baron, Wise, Lambert, Frackowiak, *et al.*, 1997) and rhythm processing (Brochard, Dufour, Drake, & Scheiber, 2000; Sakai, Hikosaka, Miyauchi, Takino, Tamada, Iwata, *et al.*, 1999). On

the other hand, the supramarginal gyri are generally considered to be part of an extensive, multimodal, associative region, involved in different complex functions such as working memory (Henson, Burgess, & Frith, 2000; Jonides, Smith, Koeppe, Awh, Minoshima, & Mintun, 1993; Mottaghy, Doring, Muller-Gartner, Topper, & Krause, 2002; Paulesu, Frith, Bench, Bottini, Grasby, & Frackowiak, 1993; Platel *et al.*, 1997) and the direction of attention towards novel, deviant or relevant stimuli (Downar, Crawle, Mikulis, & Davis, 2001, 2002; Kiehl, Laurens, Duty, Forster, & Liddle, 2001; Sevostianov, Fromm, Nechaev, Horwitz, & Braun, 2002). They have also been found to be activated during certain aspects of music processing: pitch recognition (Breier, Simos, Zouridakis, & Papanicolaou, 1999); timbre and melody processing (Platel *et al.*, 1997); rhythm processing (Brochard *et al.*, 2000).

We can conclude tentatively that this initial evidence seems to confirm not only the effectiveness of the paradigm, but also that different cerebral activity patterns correspond to mental representations deriving from different musical genres. Moreover, and consistently with our model, these patterns are influenced by individual characteristics (in this case, gender: for more details see Nardo, Londei, Iannetti, Pantano, Lenzi, Olivetti Belardinelli, *et al.*, 2004).

We suggest that this research confirms the heuristic value of our model for the interpretation of neuroimaging data of music processing. A next step is therefore planned using the same technique to assess differences between activation related to perception, and to the recognition of musical stimuli pertaining to the four categories considered.

17.7 Conclusion

In this chapter, we attempt to show that musical creativity is present in every form of music processing. It is, in fact, tied to individual modes of reducing the discrepancy produced by the input information, i.e., to the listener's cognitive style. By this term we mean internal stable states that modulate incoming information. Individual cognitive modes shape the central multimodal representation of incoming stimuli, and can be detected in brain activation patterns related to music processing. Within the framework of this model, the previously fragmented search for anchor points during music processing may provide definite support for one of the three neuropsychological perspectives on the specificity of mental representation of music. On the basis of existing evidence from neuroimaging research, we believe that only the *local theory* seems to be uncorroborated. In such a complex research field, this is a relevant result.

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Part VII

Computer models of creative behaviour

18 Creativity studies and musical interaction

François Pachet

18.1 Introduction

It is difficult to talk about creativity – musical creativity in particular – in a scientific context. Creativity has been addressed for some time by various research communities in social science, psychology, cognitive science, and artificial intelligence, with the surprising effect of turning an elusive word into a research theme, and sometimes even into a fully-fledged scientific "issue". There are now formal definitions of creativity, theories of how it can happen, how it can be explained, and even how to train oneself to become more creative. As a consequence, creativity has been trivialized to a point where many researchers profess to find it in the behaviour of virtually anything human or artificial. This dense but paradoxical landscape makes it difficult to say something new about creativity, let alone something creative.

One of the difficulties of this endeavour is, from our point of view, probably related to the desire of measuring the output of humans objectively with the goal of directly assessing the creativity of the performer as such, in the absence of a precise notion of creativity. Actually, most of the works in creativity assessment consist of proposing both a definition of creativity and a method for its assessment. This desire is itself motivated by the need to write scientific papers, where formal evaluations and assessments have become a necessity. From our point of view, the danger of such an approach is that it tends to formulate definitions that exclude the most important and interesting aspects of creativity – mainly subjective ones – and favours scholastic studies on relatively marginal phenomena, resulting in shallow analysis of musical features and behaviours.

Although we agree that creativity can be reflected in objective productions, and can possibly lead to some sort of measurement, the position we take in this chapter departs from traditional creativity studies in at least two ways. First, we address creativity from a subjective viewpoint, as a personal feeling of creating something new and interesting, associated with some specific context of production, and we position this stance in the context of creativity studies. Secondly, we focus on a non-natural form of musical activity –

interactions with computer systems – as opposed to composing or performing in traditional contexts.

18.2 Creativity studies and computer interaction

This section reviews the state of the art in creativity studies concerning the use of computers for musical activities, with a particular focus on interactive systems.

18.2.1 From Mozart to myself

The trivialization of the concept of creativity, although debatable, has one major benefit. Indeed, one of the most productive "results" of creativity studies is probably to have progressively reduced the scope of the concept of creativity from the studies of well-known geniuses to individual, routine forms of creation. Boden (1990), for instance, distinguishes creativity of a community from creativity of an individual (her so-called historical and psychological definitions of creativity). The reduction of the scope of creativity is useful because individuals can be studied with more precision than communities. At the highest level, creativity can describe phenomena happening at the scale of musical history: the history of music is filled with geniuses of all kinds, with sharp transitions, revolutions, intertwined with periods of stylistic stability, or sometimes regression. The works of Gesualdo, for instance, are still considered by many musicologists as definitely innovative, and yet are considered as some sort of mystery in the history of Baroque music. Beethoven composed many melodies that have spread throughout Western culture and hold a place in music history as unique works of art. More recently, the Beatles revolutionized popular music by breaking through many musical dimensions, borrowing elements from classical music to invent a new musical language. However, asserting that these artists have been extremely creative is probably as fair as it is trivial.

On a more specific level, one can try to distinguish what makes a given work so special or creative with regard to other works by the same artist. But to our knowledge such an endeavour has rarely been attempted with success and precision. This very task of identifying where creativity lies raises so many issues (concerning consensus or lack thereof, analysis methods, etc.) that it is probably unsolvable. Since the creativity of great artists makes sense only within a given culture, it probably *is* a substantial part of the culture, and consequently there may not be much else to say about it from a scientific viewpoint.

In this work, we aim at further reducing the scope of creativity by focusing on tasks involving a normal performer and computer software, without dissociating the two. In some sense, we introduce a new focus for creativity studies: systems composed by a human and an interactive machine.

18.2.2 Enhancing creativity

The idea of enhancing creativity has received particular attention in creativity studies. Although the very idea is debatable (after all, why would one want to enhance creativity in the first place, and, more importantly, are there efficient ways of achieving such an ambitious goal?), enhancing creativity has been addressed for a long time, and it is considered normal today to target such a goal in the classroom for all sorts of activities. Nickerson (1999), for instance, reviews the main approaches in creativity enhancement in the classroom. It is important to note that most of the approaches in creativity enhancement are based on specific organizations of the curriculum, e.g., brainstorming sessions and ways to facilitate divergent thinking. Our approach here is not to consider a particular organization of teaching, but to consider the issue of creativity enhancement from the viewpoint of system design, i.e., how to design computer systems that can lead to creativity enhancements in lay persons or children.

18.2.3 Creativity studies focusing on existing musical practice

One important question in creativity studies concerns the assessment of systems that enhance creativity. Creativity has to do with the eventual production of artefacts that are clearly visible and observable. In our context, the artefacts are music productions, which can be represented in various ways, such as scores or audio or video recordings. Webster (1992) reviews the main approaches in assessing musical creativity, including psychometric studies, cognitive studies, analysis of music content, as well as analysis of the music composition process. Worth noting in these studies are the experiments on analysis of music content performed by Loane (1984), who discusses children's compositions in relation to their cultural environment. The experiments by Bamberger (1977) are very interesting in our context because they highlight the central issue of *decision making* in composition. Flohr (1985) more particularly studied music improvisation by children, and proposed musicological analysis of these improvisations performed under various constraints (free improvisation or improvisation by mimicking input rhythm, melodies, etc.).

Assessment in all these approaches is based on a "direct" production of users, i.e., the situation where the user produces some output, with no system feedback. The production can be free (improvisation) or constrained (e.g., in response to some stimulus), but the situations studied are always based on a simple user-to-production chain.

Webster (2001) reviews the use of computer technology for music education and even dares to make predictions or suggestions for the development of future technologies, but concentrates mainly on straightforward techniques of computer-based composition and performance. Such a position is hard to defend because the developments and innovations in music

technology are, by definition, unpredictable, in much the same way that musical works created by creative composers are unpredictable. In any case, they have never been the results of suggestions by scholars.

18.2.4 Assessing creativity

18.2.4.1 Assessing the creativity of musical content

Many studies of creativity have addressed the issue of assessing musical content directly. Music lends itself quite well to various sorts of measurements, in particular tonal music, because of the many dimensions of music that have been formalized throughout the history of tonal music. Pitch contours, rhythm patterns, harmonic modulations, etc. are easy to spot and measure, and several authors have used these dimensions of music theory to assess the productions of various categories of users. The relation to creativity, however, is not clear (e.g., Folkestad, Hargreaves, & Lindström, 1998). Simple counterexamples suffice, in our view, to dismiss content analysis for assessing creativity in the large. For instance, there have been numerous attempts at copying the style of well-known composers (both classical and pop music). These copies have, by definition, the same musical elements (patterns, etc.) that musical analysis would detect, but are never considered as interesting as the originals and certainly not as creative. In these conditions, it is difficult to consider direct content analysis seriously for creativity assessment.

As we will see below, however, content analysis can be useful to compare outputs produced by the same user under different circumstances (e.g., with and without the use of a computer system).

18.2.4.2 Flow and musical creativity

Besides assessing content, one can observe psychological reactions of users in psychometric studies, for example. One particularly relevant aspect of subjectivity concerning creativity is the notion of personal enjoyment, excitement, and well-being.

To this end, we consider Mihaly Csikszentmihalyi's theory of Flow (Csikszentmihalyi, 1990). This theory is an attempt to describe the so-called *optimal experience* as experienced by creative people. The word Flow itself describes the psychological state creative people claim to reach when they are engaged in their favourite activity. The reason why we think the theory of Flow is well suited to assessing our musical experiments is that it captures, or at least attempts to capture, what we think are crucial elements of the creative process: in particular, excitement, surprise, and the gradual transformation of the musical activity into an autotelic activity; i.e., an activity that is or becomes *self-motivated*.

Csikszentmihalyi's notion of Flow describes the so-called optimal experience as a situation in which people obtain an ideal balance between skills and

challenges. Two emotional states of mind are particularly stressed in this theory: anxiety, obtained when the skills are clearly below the level needed for the challenge; and boredom, when the challenges are too easy for the skill level. In the middle lies Flow. Other states can also be described in terms of balance between skills and challenges (see Figure 18.1). One important motivation for studying Flow lies in the origin of well-being which, according to Csikszentmihalyi (1990, p. 189), is to be found in particular forms of interactions:

> The phenomenology of Flow suggests that the reason why we enjoy a particular activity is not because such pleasure has been previously programmed in our nervous system, but because of something discovered as a result of interaction.

This point is particularly important in our study because we aim precisely at designing new forms of interaction that may enhance creativity by providing Flow experiences. Of course not all forms of interaction are Flow-generating, and it is precisely the goal of Pachet (Chapter 19, this volume) to propose a particular architecture for building computer systems that can generate Flow experiences.

The theory of Flow has had some success in experimental psychology over the past 10 years, in many different domains. It has been considered for music also, for obvious reasons. For instance, Sheridan and Byrne (2002) advocate the use of the theory of Flow as an assessment measure for musical creativity in classrooms. Byrne, MacDonald, and Carlton (2002) examine possible relations between Flow and musical outputs of students in composition, using the technique of experience sampling forms (Csikszentmihalyi & Csikszentmihalyi, 1988). These studies tend to show that there is indeed a relation between Flow and creativity, at least in standard music composition tasks as performed by music students.

More precisely, Csikszentmihalyi describes the state of Flow as consisting of several fundamental traits where the balance between challenges and skills is probably the most important. Other traits are:

- focused attention;
- ease of concentration;
- clear-cut feedback;
- control of the situation;
- intrinsic motivation;
- excitement;
- change in the perception of time and speed;
- clear goals.

Because Flow is defined using relatively precise traits, one can envisage precise criteria for evaluation. The state of Flow is in fact rather easy to detect. We

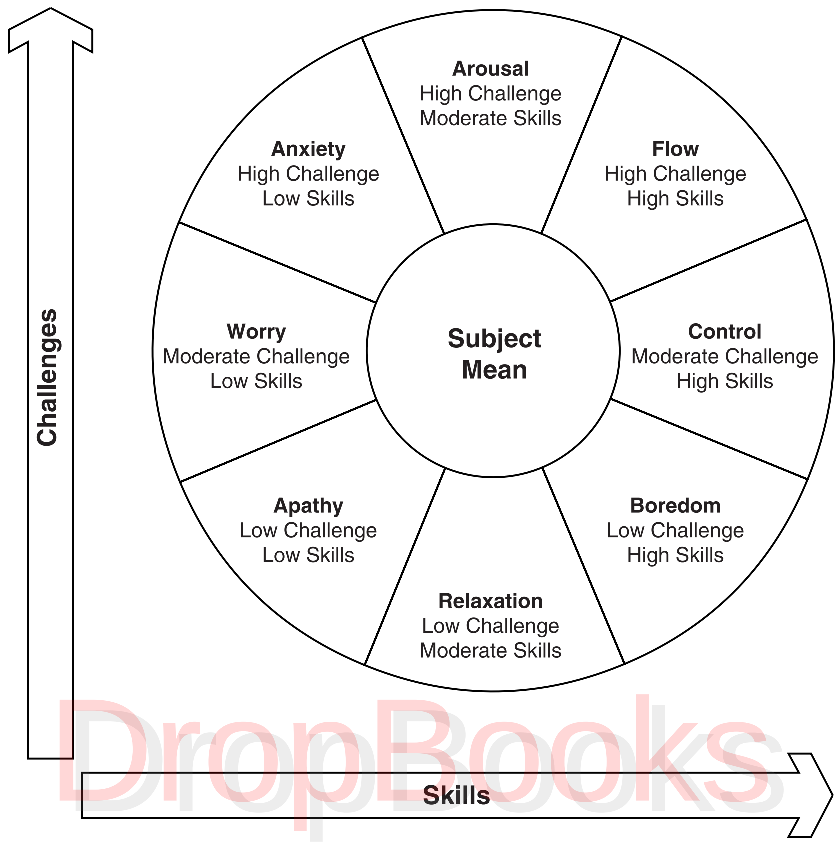

Figure 18.1 Csikszentmihalyi's Flow diagram describes various emotional states, such as boredom or anxiety, according to the balance between skills and challenges for a given activity.

consider in this work that Flow is central to the design of interactive systems that enhance creativity: if we consider Flow as a prerequisite for creativity, then creativity enhancement can be achieved indirectly by augmenting the chances of creating Flow experiences.

18.2.5 Playing and composing music with computers

In this section, we review some of the major developments of computer systems for assisting musical composition and improvisation and their links to creativity studies. We first review standard computer-assisted composition environments, then style-modelling programs, and finally interactive music systems.

18.2.5.1 Computer-based music composition

Many, if not all, studies of musical creativity have been based on the use of *standard* computer-based music composition systems. Although these tools are often referred to as "new technologies", they are usually standard computer programs such as sequencers or sound-effect processing systems, e.g., as described in Savage and Challis (2001). In the same vein, Folkestad *et al.* (1998) describe in detail the process of music composition using a standard MIDI-based sequencer, and infer from these studies various composition strategies adopted by children in this context, such as *vertical* and *horizontal composition strategies*.

18.2.5.2 Computer music generation programs

The issue of building computer programs that generate music automatically has been addressed since the very origin of computer science. Pearce, Meredith, and Wiggins (2002) give an account of this history and its debatable relation to *musical* creativity. Indeed, one can wonder to what extent computer music generation programs can be said to be creative or not, and Pearce *et al.* give several useful guidelines for such an endeavour, focusing in particular on evaluation issues. These studies show that the question of evaluating whether or not a given composition is creative *per se*, without referring to a specific context, seems to be a dead end. But if taking the context into account is recognized as crucial, there is no simple way to do so.

Here, however, we are not dealing with the issue of how to make computers creative. We believe that the human composition process is, to our knowledge, still not understood well enough to attempt to model on computers, although we sketch in the next chapter some preliminary hypotheses and experiments along these lines.

Neither are we interested in models of creativity *per se*, whose aim it is to explain how creativity works in humans considered as rational agents, as exemplified by Macedo and Cardoso (2001). Although such models may provide insights in creativity studies, they are usually based on abstract concepts (agents, speech acts) whose practical utility is debatable in our context.

We are, on the contrary, interested in human-machine interactions, and how creativity can stem from such interactions. By interaction, we mean the real-time relationship between a human user engaged in a musical activity and a program. Interactions are not bidirectional in our context, and we are strictly interested in: the objective output of the coupled user+system; and the psychological impact on the user. In particular, the creativity observed is to be assessed with regard to the normal activity of the user without the program.

In other words, we are not interested in creativity stemming from purely human activities, nor in creativity of software, but in creativity arising from *interactions* with machines. More precisely, we are interested in system design, i.e., how to design interactive systems that may provide such personal

experiences. This point is particularly important as it differentiates our approach from most other approaches in computer music creativity.

18.2.5.3 Style modelling programs

Style modelling programs are one particular sort of computer music generation program, and because of their recent success, they deserve a special mention here.

Considerable research has been done in the fields of artificial intelligence and information theory regarding the technical issue of learning a musical style automatically in an agnostic manner. Shannon (1948) introduced the concept of information based on the probability of occurrence of events in communications (messages). This notion was used soon after to model musical styles, one example being Brooks *et al.* (1957). These early experiments showed that it was possible to create pieces of music that would sound like given styles by simply computing and exploiting probabilities of note transitions. More precisely, given a corpus of musical material (typically musical scores or MIDI files), the basic idea was to analyse this corpus to compute transition probabilities between successive notes. New music can then be produced by generating notes using these inferred probability distributions. A good survey of state-of-the-art, Markov-based techniques for music can be found in Triviño-Rodriguez *et al.* (2001), including variable-length Markov models in particular, which capture stylistic information more finely.

One of the most spectacular applications of Markov chains for the generation of music is probably the Experiments in Musical Intelligence (EMI) system designed by David Cope (Cope, 1996, 2001), although his musical results are not produced entirely automatically. Although the use of Markov techniques is not explicitly mentioned, EMI is, like the other style modelling programs, based on a principle of analysis and recombination of musical elements (notes, patterns, etc.). These elements are extracted from a corpus of works, and annotated using high-level structural information. The extraction process is not always automatic and in any case not in real time (for technical details see Cope, 1996, 2001). The system is mostly known for its spectacular productions of "music in the style of X". Douglas Hofstadter, one of the greatest admirers of Cope's system, says the following about EMI (Cope, 2001):

> In twenty years of working in artificial intelligence, I have run across nothing more thought-provoking than David Cope's Experiments in Musical Intelligence. What is the essence of musical style, indeed of music itself? Can great new music emerge from the extraction and recombination of patterns in earlier music? Are the deepest of human emotions triggerable by computer patterns of notes?

It is important to note here that the initial motivation in the development of

Cope's EMI was not to perform style imitation, but rather to help the author explore his *own* musical style (Cope, 2001):

> When he created a computer program that composed music, David Cope didn't intend to cause an uproar; he was only looking for a new way to approach his own composing. But Cope's invention, Experiments in Musical Intelligence (EMI), sparked both amazement and outrage (one distressed musicologist went so far as to accuse Cope of having killed music as we know it).

This point has been somehow minimized with regard to the success of the fancy imitation games the system leads to. In our view, however, the interaction between Cope and his system, which is much less advertised, is the crucial point for several reasons. First, there are still a lot of processes in EMI that are not automatic and require manual input. Second, it is precisely the question of the exploration of a musical identity that is at stake here, and not so much the actual production of imitations. However, the interaction aspects of EMI have so far been hidden, and it is the purpose of our work to make this type of interaction explicit.

18.2.5.4 Music interaction systems

Interactive music systems have been developed since the early days of computer music, and have blossomed in particular since the invention of the MIDI protocol, and, in the early 1980s, the MAX visual programming language. These standards and languages have made it possible to insert processing modules in the music perception–action loop, resulting in many new approaches to music performance. Rowe (1992) proposes a detailed analysis of the technical issues related to the design of interactive systems, and classifies interactive systems according to various dimensions. In particular he distinguishes between two main paradigms in interactive music systems. In the "instruments" paradigm, the goal is to construct an extended musical instrument. This approach is exemplified by the Hyperinstrument thread of research led by Tod Machover (Paradiso, 1999), in which the issues of intimate control and expressiveness are the key. Musically, the goal is to enhance expressiveness while allowing the musician to retain control. The musical results of the coupled user+machine are of the same nature as with traditional instruments: solos. The other paradigm is the "player" paradigm, in which the constructed system exhibits some musical personality. The musical outputs are thought of as duets between a human and a machine. This distinction is fundamental, as it corresponds to two basic forms of music production (solo and duet). However, as proposed by Pachet (Chapter 19, this volume), we can think of another paradigm, which lies in the middle: duets with oneself, or extended solos.

Many pieces have been composed for interactive systems, leading to a

substantial amount of technical work, described in particular by Rowe (2001). Jean-Claude Risset has also composed interactive pieces for MIDI piano (Risset & Van Duyne, 1996). In these pieces, pre-programmed, real-time musical transformations are applied to musical sequences played on a MIDI piano. Each transformation defines the substrate of a piece. These transformations are applied to the local user input; for instance, each musical phrase is transposed and transformed into various arpeggios.

Interactive music has also produced interesting developments in the commercial field. Many synthesizers today offer sophisticated interactive modes, from basic one-touch chords to fully-fledged real-time orchestral accompaniments (e.g., the Yamaha PSR series). Although these developments have traditionally been despised by the scientific community, they do offer very interesting and innovative interaction modes, which are as yet under-explored in creativity studies. For example, the interaction modes developed to trigger harmonic accompaniments using a limited set of keys (root + white key for major chord, root + black key for minor chord, etc.) have a notable impact on the playing modes of users, which are still largely undefined.

Synthesizers in the professional domain are much more impressive and equally ignored by scientific studies. The Korg Karma workstation launched in 2000 offers an impressive range of new interaction modes, intimately integrated in state-of-the-art sound synthesis modules. The interaction modes are based on the notion of "musical effect" (Kay, 2000). An effect may be seen as a generalization of the notion of "transformation" as defined in interactive music research, to account for both user inputs and predefined music styles. An effect in this terminology is a way to integrate user input in a predefined musical style in a meaningful way. Effects can be very simple (arpeggiators) or very complex (generation of whole orchestral textures and ambiences from simple key strokes). The Karma workstation in its basic states offers about a thousand different settings, each corresponding to a particular music ambience, style, or mood. For each setting, about 10 real-time control parameters are proposed, with varying semantics, including rhythmic density, syncopation, manner of arpeggiation, etc.

The only information we have concerning the use of such instruments comes from popular information channels. For example, the well-known composer and singer Phil Collins (2001) declares in an interview that he uses the Karma for composing.

Collins uses the Karma to write new material as well as to freshen up and expand grooves on existing material. Commenting on a few of Karma's features, Collins (2001) says:

> Some of the grooves are fantastic. I can see using 8 or 16 bars and looping it. The tempo shifts make it a breeze compared to trying to recycle these old CD-ROMs. You get in there and try to split them up and then you find that you can't slow it up quite enough to keep the groove, so you have to go back and edit it again. I find the ease with which you

can just shift the tempo with the Karma and actually get it to loop pretty invaluable for me, because my home studio is not really a place for live drums. Since the time of "In The Air Tonight" onwards I've always been big on atmospheric loops, and some of these things just ooze all that atmosphere.

No study has, to our knowledge, been performed on such environments, but it would be extremely revealing to measure how long users remain interested in interactions using such pre-programmed effects, how they can actually boost creativity for both composition and real-time performance, and to what extent the comments by well-known musicians are true and reproducible.

18.3 Conclusion

This chapter has introduced the notion of interactive systems as a theme for creativity studies. We described several approaches in interactive systems aiming at enhancing musical creativity, and conversely sketched some works in creativity studies that can be related to understanding creativity with interactive systems. This position is probably preliminary, as no systematic study of creativity involving interactive systems has been conducted, to our knowledge. Additionally, we stress the fact that many popular interactive music systems have been in use by the general public for more than a decade, and that this situation creates a natural and rich area to study for those wishing to gain new insights into creativity.

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19 Enhancing individual creativity with interactive musical reflexive systems

François Pachet

19.1 Introduction

Can we design interactive software that enhances individual creativity in music improvisation? This chapter attempts to answer this question in the affirmative, and further proposes a class of interactive systems to achieve this goal. The question of enhancing creativity has been addressed by various researchers in creativity studies, as sketched in Chapter 18 of this volume. An analysis of previous work in creativity studies and in computer music generation reveals the following important characteristics:

(1) Creativity studies involving the relationship between users and computers have addressed only existing – and relatively old – music software. Consequently, the conclusions of these studies cannot be used to *design new software* in particular interactive environments. So far, no study has been conducted that relates interactive music system design with creativity enhancement.

(2) Existing approaches to computer-generated music are usually based on *non-interactive* systems (e.g., EMI, see Cope, 2001). Although the techniques for computer analysis and generation of musical style are relevant to our aim, the notion of style replication is usually not considered in relation to subjectivity.

(3) Existing approaches to interactive music are usually based on preprogrammed interaction modes, which generate various types of musical transformations or effects. Although more studies could be devoted to interactive music systems and their relationship to creativity, it can be said that they are limited, by definition, because they do not allow a *scaffolding of complexity*, and are therefore usually delimited to the composition of a particular musical piece.

(4) The theory of Flow focuses on situations where there is a balance between challenges and skills. Such a balance depends on the individual. A simple and effective way to achieve it is to develop specific kinds of *musical mirroring effects*. By construction, the level of challenge, represented by the behaviour of the system, always corresponds to the level of the user.

This chapter is an attempt to generalize from these remarks in the light of creativity studies, and introduces the notion of *interactive musical reflexive systems* as a way of integrating and satisfying the various criteria listed above. In Section 19.2, we introduce the notion of interactive reflective musical systems and reconcile their structure with the theory of Flow. We illustrate the architecture in Section 19.3, with three interactive systems designed at the Sony Computer Science Laboratory, for which we describe several past and ongoing experiments.

19.2 Interactive reflexive music systems

We are interested in a novel class of computer systems that introduce a feedback loop in the music production process. This class of systems is referred to here as *interactive reflexive musical systems* (IRMSs). One important characteristic of these systems is that their main point of interest lies not so much in the *quality* of the music produced, which is largely dependent on the skill level of the user, but in the *difference* between what is produced *with* the system and what the user would produce *without* it. The experience of playing with an IRMS can lead to states of Flow (see Chapter 18) that may eventually trigger creative behaviours or creative output. We first introduce the abstract principles of IRMS and then illustrate the architecture in various incarnations and report on experiments performed with these systems.

19.2.1 Definition

More precisely, we propose to consider the class of interactive systems in which users can interact with virtual copies of themselves, or at least with agents that have a mimetic capacity and can evolve in an organic fashion. To make this imitation efficient, there are a number of characteristics that we consider important in defining *reflexivity* in interactive systems. We propose the following list, by no means exhaustive, or even prescriptive, to be taken as a starting point:

- *Similarity or mirroring effect*. What the system produces sounds like what the user himself or herself is able to produce. This similarity must be easily recognizable by the user, who must experience the sensation of interacting with a copy of himself/herself. Similarity is not equivalent to mirroring. For instance, a systematic echo or repetition of the phrases played by the user does not induce such a sensation.
- *Agnosticism*. The system's ability to reproduce the user's personality is learned automatically and agnostically – i.e., without human intervention. In our case, for instance, no preprogrammed musical information is given to the system.
- *Scaffolding of complexity*. Interactive systems are not designed only for short demos. Since the user is constantly interpreting the output of the

system, and altering their playing in response, it is important to consider the longer term behaviour of the system. Incremental learning ensures that the system keeps evolving continuously and consequently that the user will interact with it for a long time. Each interaction with the system contributes to changing its future behaviour. Incremental learning is a way to endow the system with an organic feel, typical of open, natural systems (as opposed to preprogrammed, closed-world systems).
- *Seamlessness*. The system produces output that is virtually indistinguishable from the user's input. Note that this characteristic does not apply in the case of "classic" hyper-instruments, where the sonic effects are entirely produced by the system, and therefore do not directly match material directly produced by the users.

One important consequence of reflexive systems is that the centre of attention in the interaction process is not so much the *end-product* (the music) as the *subject* engaged in the interaction. Engaging in an interaction with a reflexive system is therefore a means of discovering oneself, or at least exploring one's ability in the domain at hand (in our case, musical improvisation). This natural, deep interest in exploring oneself – particularly during the early years of childhood – is a key to self-motivation. The success of IRMSs is largely based on the fact that individuals are naturally inclined to discover their own personalities. In some sense, these systems are an extension of the "second self" (Turkle, 1984), where the machine seems not only to think, but to think like the user. An interesting consequence of this is a reversal of roles: the student becomes the teacher; the user teaches the machine about themself.

We will give concrete examples of IRMSs below. Counterexamples abound also. For instance, at first glance, a Vocoder may be seen as an IRMS. The carrier signal (e.g., a voice) can be seen as a real-time input, and the modulator (e.g., another audio input played on a synthesizer) as the contextual input. The output is generated by triggering a musical stream from the carrier, biased by the modulator. However, there is no learning component in a Vocoder, and therefore no increase in complexity. The Vocoder is a form of musical mirror.

19.2.2 Content analysis and production

The output of an IRMS is based on the analysis of the accumulated inputs of the user in a session, and must satisfy these major criteria:

- It must produce an impression of similarity;
- It must conform incrementally to the personality of the user;
- It must be intimately controllable.

The scaffolding of complexity is ensured by an explicit feedback loop in the

system involving the user. Musical information given by the user is processed and recombined to produce new material, with which the user may interact, in turn, to produce more material. The close relationship between the user and the system's production ensures that this feedback is both meaningful and effective.

Concretely, the musical output must typically lie between two extreme forms of musical production: repetition and randomness. Repetition is obtained by echoing musical elements of the user, without any reorganization. Repetition creates a sense of mirroring, but does not exhibit any increase in complexity. Randomness can exhibit complexity but is not related to the user's personality.

There is another balance to be obtained by the output, namely between a strong personality (in principle as close as possible to the user's) that is insensible to context, and a strong contextualization (as exemplified, for example, by the Korg Karma workstation) that does not exhibit any personality. These balances can lead to the introduction of various control parameters which are generically indicated as such in Figure 19.1. Technically, it involves a balance between user inputs and contextual information, which is described in Section 19.2.3.3.

19.2.3 Logical architecture

19.2.3.1 Inputs and output

The logical architecture of an IRMS is relatively simple and stems from the analysis above. It consists of dissociating three main input types, to produce only one output (see Figure 19.1). The three main inputs correspond to the three basic sources of information needed by the system:

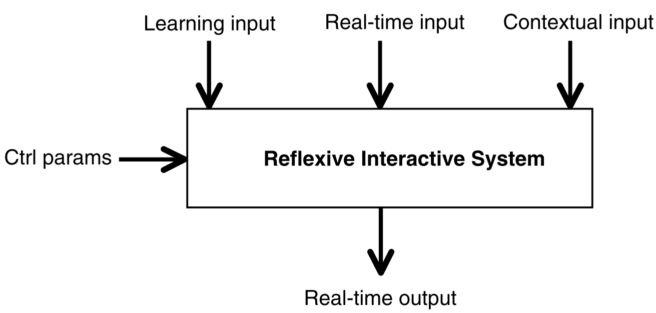

Figure 19.1 The global architecture of IRMS, with three inputs and one output.

- *Input for learning*. This is where data, analysed in order to build the progressive model of the user, comes from.

- *Real-time input*. This is what *triggers* the output of the system.
- *Contextual input*. This is information provided to the system, also in real time, to *control* its production. This information can be seen as an attractor to bias the generation of the system towards a particular musical region.

In some situations, these three inputs can be the same. For instance, in the basic version of the Continuator (see Section 19.2.3.3), the learning and real-time input are the same, and come from the main user. There is no contextual input. In the second version, the learning input is used in a preliminary phase. During the interaction, the real-time and contextual inputs are the same.

An IRMS has only one output, its main production. However, several instances of the system can be launched simultaneously, allowing multichannel outputs and more complex interactions in general. Additionally, control parameters can be fed to the system, but their importance is marginal in this design.

19.2.3.2 Analysis and generation modules

The core system is itself decomposed into the following modules, which are instantiated in the final applications:

(1) segmentation of the various inputs into chunks;
(2) gradual learning of input;
(3) analysis of global parameters in the real-time input;
(4) generation of the output based on the learned model, contextual input, control parameters, and global parameters analysed from the real-time input.

This specification is deliberately general, but its aim is to offer the most generic framework for building IRMS systems, without being too arbitrary. We have proposed a design and an implementation for these modules based on an extended Markov model of musical sequences. We summarize here the most salient elements. More details are given by Pachet (2003). However, other learning techniques could be used to achieve similar effects – either Markov-based techniques or techniques based on different learning models such as artificial neural networks. The model we present here is intended to lead to efficient implementations and was tried out in various settings.

(1) Segmentation. *A phrase-end detector* that is able to detect that a musical phrase had "ended". Detection is based on an adaptive temporal threshold mechanism. The threshold is inferred from the analysis of inter-onset intervals in the input sequence. As a result, if the input sequence is slow (or, rather, contains few notes per second) then the threshold is increased;

otherwise it is decreased. This simple mechanism ensures that the continuation will be temporally seamless.

(2) Gradual learning. *A pattern analyser*. Once detected as complete, the input sequences are sent to a pattern analyser, which builds up a Markov model of the sequence. The complete algorithm, described by Pachet (2002), consists of a left-to-right parsing of the sequence to build a tree of all possible continuations for all possible prefixes of the sequence. To speed up learning, the system also learns all transpositions of the sequence.
(3) Analysis of global parameters. *A global property analyser*. Various global properties of the input sequence are also analysed, such as the density (number of notes per second), the tempo, and the meter (location of strong/weak beats), the overall dynamics (loud or soft), and so on. These properties are used to produce a continuation that is musically seamless with the input.
(4) Generation. *The generator* is responsible for producing the continuation of the input sequence. The actual production of the musical material exploits the Markov graph created by the analysis module (Pachet, 2002). In essence, it consists of producing the continuation on a note-by-note basis. Each note is generated using the Markov probabilities inferred during the analysis stage. Technically, it uses a variable-order Markov generation that optimizes the relevance of each single note continuation by looking for the longest possible subsequence in the graph. Special care has been taken to perform meaningful segmentations of the input phrases for the learning phase. Indeed, real-world input phrases are never composed of perfectly successive notes or chords. In order to "cut" input phrases into chunks, which are then fed to the learning system, a segmentation process is able to detect note or chord transitions and possibly cut across unfinished notes. The module also stores the possible "residual" discrepancy, and restores it at generation phase so that the material retains the rhythmical "naturalness" of the original style.

19.2.3.3 Taking the contextual input into account

An important point in the generation module is the way it takes account of the contextual input. The basic idea here is that, contrary to usual Markov-based generation systems, the output is not determined only by the input of the user (as a continuation of this input according to the model learned previously), but can also be biased by the contextual input. This contextual input can be seen as a dynamic attractor that influences the generation further; for a given real-time input, there can be many possible continuations. A standard Markov model will be able to produce a continuation based only on probabilities of occurrences as detected in the learning corpus. However, in many cases one would like to influence the generation using information that is not contained in the learning corpus, such as a novel harmony or a melody (see Section 19.3.2 for examples).

To accommodate this need, we simply extended the basic Markovian probability scheme, as follows. We call *Markov(s,x)* the Markovian probability of drawing musical element *x*, given in input sequence *s* (*s* is here given by the real-time input). The goal of all Markov-based music generators is to compute *Markov(s,x)* quickly and accurately.

Now we also introduce an arbitrary fitness function *Fitness(x,C)*, which represents the fitness of musical element *x* according to a context *C*. This fitness can be determined arbitrarily, and can represent for instance the harmonic distance of a note given a chord.

Because *Markov(s,x)* and *Fitness(x,C)* are *a priori* independent, we aggregate them using a simple linear combination, parameterized by a variable *S* as follows, where *S* can vary from 0 to 1:

$$Prob(S,C,x) = S \times Markov(S,x) + (1 - S) \times Fitness(C,x)$$

This general probability scheme ensures that all cases can be covered. If $S = 1$, then the scheme is strictly equivalent to a standard Markovian generator. If $S = 0$ then the scheme corresponds to an interactive system where one wants to control the generation of a musical process directly by some user input. When *S* is between 0 and 1, the system tries to satisfy both criteria at the same time. *S* is considered here as a typical control parameter (see Section 19.2.3.2) and is set before a session.

Finally, the continuation sequence produced is crude, in the sense that it does not necessarily have the global musical properties of the input sequence. Therefore, a mapping mechanism is applied to transform the brute continuation into a musical phrase that will be played just in time to produce seamlessness. Currently, the properties that are analysed and mapped are tempo, metrical position, and dynamics (more details are given by Pachet, 2002).

19.2.4 Interaction protocols

Finally, the interaction *per se* obeys some given interaction *protocol*. Interaction protocols are independent of the rest of the architecture. Bolter and Gromala (2003) argue that, contrary to common practice in interface design, human–machine interfaces should not always be "transparent", and that good, useful design should allow a balance between transparency (i.e., the computer is invisible) and reflection, "in which the medium itself helps the user understand their experience of it". Indeed, one important element we have learned from our experiments (Pachet, 2002) is that there should not be any graphical interface in the standard sense of the term (with a mouse, buttons, etc.). Users engaged in creative music-making cannot afford to have their attention distracted from the instrument to the computer, however well-designed the interface may be. Therefore, all interactions with the system should be performed only by playing. Several control parameters can be made available if needed, but they are not designed to be used in real time.

Once a session is started, there should be no need to look at the computer screen or to press any button.

Different interaction protocols are possible with an IRMS. Protocols can be seen as the rules based on which the system decides to play. These protocols are independent of the actual analysis and synthesis methods used. As in conversations, these rules can be varied; question–answer is by no means the only possible interaction protocol: lectures, small talk (in the commonsense meaning), exams, baby talk, etc., are examples of communication where interaction protocols differ vastly.

The issue of interaction protocols is closely related to the idea of music as a conversation, put forward by (among others) Bill Walker in his ImprovisationBuilder system (Walker & Belet, 1999). In ImprovisationBuilder, the system is able to take turns with the player, and also to detect, in case of collaborative music playing, whose turn it is using simple analysis of the various musicians' inputs. These examples show that there is potentially an infinite number of interesting interaction protocols.

At the time of writing, several interaction protocols have been designed and experimented on with IRMSs. Here are some of them, in increasing order of complexity (and represented graphically in Figure 19.2). They are by no means exhaustive, and are given here simply as examples:

- *Turn-taking*. This mode is represented graphically as a perfect succession of turns, with no gap. The IRMS detects phrase endings, then learns and produces a continuation. It stops as soon as the user starts to play a new phrase
- *Turn-taking with delay*. The same as above, except that the IRMS stops only when the user *finishes* a phrase. This produces an interesting overlapping effect in which the user and the Continuator can play at the same time
- *Single-note accompaniment*. The IRMS produces an appropriate chordal

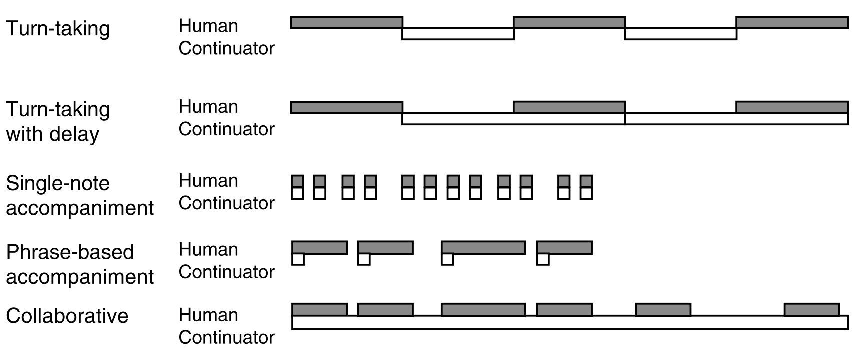

Figure 19.2 Various interaction protocols with the IRMS.

accompaniment each time a note is played, and with the same duration (stops the chord when the key is released)

- *Phrase-based accompaniment*. The same as above except that the chord is produced only at the beginning of a phrase
- *Collaborative*. In this mode, the IRMS plays an infinite stream of music (based on material previously learned). The user can play simultaneously, and what they play is taken into account by the IRMS, e.g., harmonically. The user's actions act then as a high-level control more than as a question to be answered.

These various modes are in turn usually highly parameterized: the phrase length of the continuation in turn-taking mode, the rhythm mode, the adaptation or not of the music produced to surface parameters such as dynamics and tempo. In practice, it is easy to see that an infinite number of concrete interaction protocols can be defined, all tailored to a particular situation.

19.3 Applications

This section describes several applications that can be seen as different IRMSs implemented using the architecture described above. The differences between these applications concern the variable parts of the architecture, and more precisely: the interaction mode; the nature of the various inputs (learning, real-time, and context); and the nature of the music being fed into the system (monophonic melodies, chord sequences, arbitrary polyphonic music, fixed-beat music, etc.).

For each of these applications we describe the system characteristics and experiments performed.

19.3.1 The Continuator-I: question–answer

The Continuator-I system was chronologically the first reflexive system developed at Sony CSL. Its aim is to propose a musical dialogue with the user with as little constraint as possible, but, of course, satisfying the IRMS criteria. The system is defined as follows:

- Learning input = real-time input: arbitrary polyphonic music, without any imposed metrical structure.
- Contextual input: not used.
- Interaction mode: turn-taking (see section 19.2.4). The system stops when the user plays, and reacts as soon as the user finishes a musical phrase. There is no overlap between the real-time input and the output.

The following set of examples (Figures 19.3–19.8) shows a typical interaction with the Continuator-I. For the sake of clarity, we have split the interaction into three “sessions”. Each session consists of a user playing a phrase

Figure 19.3 Session no. 1: A chromatic scale played by the user.

Figure 19.4 A continuation played by the Continuator, having learned from the chromatic scale of Figure 19.3.

Figure 19.5 Session no. 2: The user plays an octatonic scale.

Figure 19.6 A continuation played by the Continuator, having learned from the two preceding sessions, Figures 19.3 and 19.5.

Figure 19.7 Session no. 3: The user plays arpeggios in fourths.

Figure 19.8 A continuation played by the Continuator, having learned from the three preceding sessions, Figures 19.3, 19.5, and 19.7. Note how the various patterns of the sessions (chromatic, octatonic, and fourths) are seamlessly woven together.

and a continuation. The sessions are performed in a continuous manner with the real system. The idea here is to show how the user can progressively feed the system with their own music material (in the case below, different scale patterns) and get, in real time, an exploration of the accumulated material.

Similar sessions can be performed with arbitrary polyphonic music, and are described by Pachet (2003).

Although a complete analysis of the musical content produced by Continuator could be performed, it is simple to note here that the output does "sound like" the inputs given by the user. Moreover, one can see how the different "patterns" of the user are combined naturally to create new, seamless musical sequences.

Various experiments with Continuator-I were performed with professional jazz musicians and children. The observations conducted so far have demonstrated the remarkable success of the Continuator in stimulating users (professionals and children alike) to engage in musical conversations. In all cases, a systematic Flow experience was observed (see Pachet and Addessi, 2004, and Addessi and Pachet, 2005 for more details). The various criteria of Flow were all clearly reached, notably excitement and sustained concentration (see Figure 19.9). It is also quite clear, with both professionals and children, that the activity of playing with the Continuator becomes quickly self-motivated. The evolution of the interaction with the system is also relatively stable. In a first phase, users try to understand the rules of the game (which are usually not explained explicitly) and test the ability of the system to understand their style and reproduce it. This phase is usually externally motivated (obligation to do an experiment, demonstration, etc.). In a second phase, typically after a few minutes, the nature of the interaction changes, and invariably users become engaged in an exploration of their own style,

Figure 19.9 Various expressions of excitement in experiments with children and Continuator-I.

solely through their interaction with the system, without requiring any help or feedback otherwise.

19.3.2 The Continuator-II: Accompaniment

The Continuator-II uses basically the same technical modules as the Continuator-I and differs only in the variable parts of the architecture. It is defined as follows:

- Learning input: chord sequences played *before* the interactive session, and saved in a file.
- Real-time input = contextual input: monophonic melodies with no metrical structure.
- Interaction mode: single-note accompaniment (see Section 19.2.4). The system produces one chord each time a note is played by the user.

We present an example of a typical session with Continuator-II using simple chords and simple melodies (Figure 19.10) shows a chord sequence played by the user (the author, in this case) into the system. These are jazzy chords all of which sound good using an arbitrary piano sound on a typical synthesizer or MIDI piano. During the session, the user plays a melody (real-time input), and the Continuator-II produces an accompaniment to this melody in real time (see Figure 19.11). The remarkable aspect of this accompaniment is that it naturally satisfies the constraint that each chord "fits" with the current note played by the user. The fitness here is defined simply by the fact that the chord chosen by the system contains at least one occurrence of the same pitch class (this can be checked in Figure 19.11). Of course any other fitness function can be defined, as described in Section 19.2.3.3.

Because this systematic mapping of chords to each note can be tiring, several refinements can be introduced in the interaction mode. For example, a

Figure 19.10 A chord sequence entered by the user. The chords, as well as the transitions between the chords and their transpositions to neighbouring tones, are learned by the system.

Figure 19.11 A chord sequence produced from the interaction between a musician (playing a melody on a guitar) and the Continuator (playing chords in accordance to the melody). The contextual force creates harmonies that are always fluent, locally correct, and converging. In this case, each chord contains the same pitch class as the melody, possibly anywhere in the chord. However, the sequence is also full of "interesting" harmonic surprises, all created using only the chords and the melodic input of the user.

temporal threshold is introduced so that when a note played by the user is sufficiently long (say more than one second), the system toggles between an on and an off state.

This simple scheme allows the user to improvise on a chord they like for as long as they wish. To end the improvisation and resume the accompaniment state, the user has to play a sufficiently long note. This scheme is yet another example of the "no interface" paradigm, which allows the user to concentrate on the playing. It is also an example of how the user can "capture" and retain interesting musical elements produced by the system, in this case by just holding a note.

Note that such a scheme has interesting effects on the concentration involved: because the user controls the on/off switching of the system by note durations, they have to listen quite carefully to what the system is producing.

19.3.2.1 Variations

Other variations of the Continuator-II have also been tried. In particular, one can envisage the use of a fixed metrical structure to produce an interesting system in which the user literally plays alongside himself or herself. Such a system is described by Pachet (2003).

This system is defined as follows:

- Learning input: a musical piece, following a fixed metrical structure and tempo which is then saved in a file.
- Figure 19.12 shows a simple example where a Bach prelude in C is played by the user (or from a MIDI file) and learned by the system.

- Real-time input = null. The system generates an infinite stream from the learned input, there is no triggering, and the system does not stop.
- Contextual input = chords played by the user. The chords played by the user bias the generation of the stream towards a specific harmonic region.
- Interaction mode: infinite stream without interruption.

The Continuator-II first learns a given musical piece, with a fixed metrical structure (in our example, the Bach prelude, Figure 19.12). In the second phase (the actual session) the system produces an infinite sequence in the same "style" (in this case, these sequences can be described as ascending arpeggios using thirds of diatonic chords). At the same time, it tries to adapt its production to a chord (or any musical material) produced by the user in real time. The mechanism for producing this compromise consists of substituting the Markovian probability function of the generator with a function that takes into account the fitness between the continuation and the melody of the user. Figure 19.13 shows a simplified example of the output of the Continuator-II (bottom line) taking account in real time of the chords played by the user (top line), as well as the "style" learned from the Bach prelude.

Of course, this example is a musical caricature, given the space constraints of the chapter, but it shows the basic principle underlying the particular mode. In some sense, the system allows a user to literally play alongside himself or herself. In the first stage, the user teaches the system all his patterns, tricks, preferred chords, etc. Then the same user plays a melody, and the Continuator uses the learned material to produce an accompaniment. Because of the way the system is designed, it will find matches and associations between musical elements preferred by the user that would be difficult or impossible to find by hand. This is, in our view, a prototypical example of a reflexive system because the system does not invent anything new, but simply digs out and recombines material of the user in a meaningful way (in this case, the "meaning" is given essentially by the harmonic distance function). More complex examples as well as audio excerpts can be found on the author's website, http://www.csl.sony.fr/~pachet.

19.3.3 Continuator-III: Experiments in song composition

The final example of IRMS using our architecture concerns not improvisation, as in Continuator-I and II, but the process of composition. More precisely,

Figure 19.12 The Bach arpeggiator example. In a first phase, the Bach prelude in C is played and learned by the Continuator (in all tonalities).

we have started a study to observe the process of pop-song composition, where we apply our ideas concerning IRMS. We are interested in the creation process *per se*, from the generation of musical ideas, motives, patterns, to the creation of a structure, including variation of motives, repetition of structural elements, etc. Many tools have been designed to help the music composition process, from sequencers (see Chapter 18 of this volume) up to fully-fledged programming environments such as Csound or OpenMusic (Assayag, Rueda, Laurson, Agon, & Delerue, 1999). However, these environments do not really assist in the creative process, and are targeted at composers who already know what they want to produce quite well. QSketcher (Abrams, Bellofatto, Fuhrer, Oppenheim, Wright, Boulanger, *et al.*, 2002) is an example of a system designed with the goal of assisting in the early stages of the creation process, and in particular aims at capturing ideas with minimum user interaction. The system is, however, largely menu-based and involves many standard computer interactions with mouse, buttons, and drawings. Our approach to assisting early-stage composition follows the same goals, but we investigate the use of IRMS without a computer interface, and try to push the idea as far as possible.

The current state of the system is decomposed into several subsystems, corresponding with various steps in the creation process. First, a system allows the user to find "musical motives", typically a few bars long, with a chord sequence and a related melody. In this phase, the system definition is basically the same as Continuator-II except for the interaction mode:

- Learning input: chord sequences played *before* the interactive session, and saved in a file.
- Real-time input = contextual input: monophonic melodies with no metrical structure.
- Interaction mode: each note of the melody triggers a chord. When the melody is finished (as detected by a temporal threshold), the melody just played *and* its associated chord sequence are played back in a loop. When the user plays again, the loop stops, and the process starts again until the end of the new melody, and so forth.

Several variations are introduced in this basic mode, using various control schemes as in Continuator-II, such as duration or velocity of the last note played. For instance, the user can play new melodies on top of a chord sequence generated by the system without triggering a new generation. When a satisfying melody has been found, the whole sequence is saved in a repository, and can be used later as a building block for the whole song.

In a second step, the task is to produce a structure using the various building blocks created before. One of the difficulties here is to create interesting "variations" of motives.

- Learning input: a harmonized melody, i.e. a melody with its correspond-

ing chord sequence, typically generated in the first phase, and possibly saved in a file.

- Real-time input = null.
- Contextual input: chords played by the user. Ideally these chords are not heard (so-called *local off* MIDI mode), to avoid interference with the harmony being played.
- Interaction mode: the harmonized melody is played in a loop. When the user plays a chord, the system transforms the harmonized melody so that it matches harmonically with the chord (as in the Bach prelude example illustrated in Figure 19.13).

Another variation lets the user change both the harmony and the rhythm of a given harmonized melody. In this case, the system is defined by:

- Learning input: same as above – a harmonized melody, i.e., a melody with its corresponding chord sequence, typically generated in the first phase, and possibly saved in a file.
- Real-time input = contextual input: chords played by the user.
- Interaction mode: Each chord played by the user triggers one note of the harmonized melody transformed so that it matches harmonically with the chord (above). When the user plays one note of the chord again (and keeps the other notes sustained), the next note of the melody is played. When the whole melody is exhausted, it starts again. When the user plays a new chord (having released the former one), the melody stops wherever it was playing and starts again with the new chord as an attractor.

19.4 Conclusion

We have introduced the concept of Interactive Reflexive Musical System as a class of interactive systems aimed at enhancing musical creativity. The most important characteristics of an IRMS are (1) the gradual learning of musical material, which allows a scaffolding in complexity, necessary to sustain the

Figure 19.13 In the second phase, chords are played by the user (top line), and the system reacts to them by playing "Bach-like" arpeggiations (bottom line).

interest of users for long periods of time; (2) the lack of a standard graphical user interface, which allows users to concentrate on playing music without thinking about the system design. We have proposed an architecture, and explained three different applications created with this architecture. Several experiments are described with various users using an IRMS (children, improvisers, composers). The most important contribution to creativity studies is the introduction of a novel class of studies formed by the interaction between a user and an IRMS.

Finally, we believe our work is an example of a fruitful collaboration between experimental psychology and computer science. Because innovation in computer science is rarely strictly endogenous (innovative ideas in computer science often come from blending with other domains), we believe that an approach that closely integrates psychological experiments with system design is very productive and should be pursued in other domains of creativity studies.

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20 Putting some (artificial) life into models of musical creativity

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Eduardo R. Miranda

20.1 Introduction

Creating music is a social activity. Without someone to create it, perform it, and perceive it, music can hardly be said to exist. If we want to build artificial systems that can help us to create music – or, even more, that can attempt to create music on their own – we should strive to include the social element in those systems. The artificial intelligence approach to musical creativity has often been a solitary affair, constructing lone monolithic systems that come up with music by themselves (Loy, 1989). Instead, can we build a more socially motivated group of interacting artificial agents, who then create music within their social context? The answer is yes – but to do so, we need to move away from the standard conception of artificial intelligence, and enter the new world of artificial life.

The study of artificial life (or Alife for short) aims to uncover the principles of living systems in general – not just as they are manifested here on earth – including the ways that organisms adapt to and behave in their physical and social environments. To explore such questions, Alife researchers typically model natural living systems by simulating some of their biological aspects *in silico* (Langton, 1997). For instance, simulations are built with organisms or agents "living" in artificial environments that may contain resources such as food and water, hazards such as predators or poisons, and other agents that provide opportunities for fighting, mating, or other types of interactions. These models are often simplified down to just the features that are essential to answer some question of interest – for instance, if researchers wanted to study how signalling can reduce conflict, agents might just have the abilities to generate and perceive signals, to fight and move away, and to guard territories, but not to eat or reproduce.

The attempt to mimic biological phenomena on computers is proving to be a viable route for a better theoretical understanding of living organisms, as well as for the practical applications of biological principles for technology (in robotics, nanotechnology, etc.). Because Alife deals with such complex phenomena, its growth has fostered, and been fostered by, the development of a pool of research tools for studying complexity, including cellular automata,

genetic algorithms, and neural networks. These tools in turn are proving to be useful in fields beyond biology, most notably the social sciences (Gilbert & Troitzsch, 1999) and linguistics (Cangelosi & Parisi, 2001; Kirby, 2002). Given that art has always availed itself of the latest technological advances, it comes as no surprise that ideas and techniques from Alife are now finding their way into both visual art (Todd & Latham, 1992) and music (Dahlstedt & Nordhal, 2001; Degazio, 1999; Miranda, 2002a; Todd, 2000; Todd & Werner, 1999).

The agent-based modelling methods developed by the Alife community provide a rich framework within which to build systems of socially interacting individuals. The question now is: what components are needed in these models to explore the creation of music? In this chapter, we will describe three main ways of building artificial life models whose inhabitants create music not only for their human listeners, but in some cases for each other as well: converting non-musical behaviour into sound, evolving songs to meet some external critic's desires, and letting artificial musicians and their audiences co-evolve in their ersatz world, creating their own musical culture as they go.

Using artificial life systems to create music can address a number of goals for people interested in musical creativity. First, for music psychologists and musicologists, it offers a framework within which models of human musical cognition and behaviour can be built and tested in a simulated social setting, allowing the exploration of how melody, harmony, and rhythm may emerge through interactions between listening and performing individuals, and of how musical cultures can be built up through repeated such interactions over extended periods of time. Second, it can enable biologists to explore the evolution of the underpinnings of musical behaviour in populations of agents (whether simulated humans or other animals) facing a variety of adaptive challenges. Third, for creators of musical tools it provides a new approach to computer-assisted creativity that can produce open-ended variety (and can be connected with compelling images as well). And finally, for musicians it can yield a rich new source of naturally-inspired complexity to draw upon in making their own creative musical pieces. In this chapter, we will present examples of musical artificial life systems applied to a number of these goals; others await development by further inspired individuals.

20.2 Approaches to using Alife models of interacting agents in music

To help lay out the space of possibilities of creative musical applications of Alife models, we develop here a new framework for comparing these models along a crucial dimension. There have been a number of interesting applications of Alife models in music, ranging from associating musical notes with the cells of cellular automata (Hunt, Kirk, & Orton, 1991) to building genotypes of musical parameters for generating music using genetic algorithms (Degazio, 1999). However, what is lacking in these applications is the presence of social interaction between individual musical agents, from which interesting

sonic creations might arise. Because social interaction is central to the goals of musical creativity we laid out earlier, here we focus our framework on Alife modelling approaches that generate musically relevant social dynamics in the emergent behaviour of interacting agents.

We start by identifying three main ways of adapting Alife models of interacting agents to the task of musical creation, before considering each approach in detail in the next sections. First, we can construct models of artificial agents going about their business in their simulated world – say moving around, looking for food, avoiding bumping into rocks and each other – and as they behave, we convert some aspects of their behaviour into sound and listen to them. These agents are not musical in the sense that they are not designed with any musical task in mind. Rather, some sort of *sonification* (or *musification*) to their behaviour patterns is applied in order to hear what emerges. Their social interactions will affect the music we hear, but the music being produced will not affect their social interactions, nor anything else about their lives; instead, the music is a side-effect of whatever the agents are doing.

A second, more directly musical approach is to let each individual produce its own music – its own song, for instance – as it goes about its existence, and to use this music to determine the survival or reproduction of each agent. The songs present in the population can evolve over time: more successful songs, that is, those leading to greater survival and reproduction of the individuals singing them, will consequently be represented by more copies of similar versions in the next generation, sung by the children of the reproducing individuals. This artificial evolutionary process can lead to more complex or interesting pieces of music if allowed to go on long enough. In models of this type, music production is intrinsic to each individual, rather than merely being a consequence of non-musical behaviour as in the previous approach. The music an individual produces has material consequences for its own life in turn, so that in some sense the music matters to the agents.

However, this is not yet really social creation of music, because the music produced by an individual is not heard and reacted to by other individuals in the population, but instead is evaluated by some external almighty critic. This critic can be an artificially designed judge, such as an expert system looking for particular melodic or harmonic developments. Or it can be a human user, listening to songs one at a time or to the music composed by the whole population at once, and rewarding individuals who produce more pleasing songs, or musical parts, with more offspring. So, although a population of individuals is creating music here, each individual still remains blissfully unaware of what the others are singing, and the truly social element is still lacking from the musical process.

The third approach to using Alife models for music composition finally gets at actual social interaction on the basis of the music created by individuals. In this case, agents produce musical signals that are heard and reacted to by other agents, influencing for instance the songs that they

themselves sing, or their proclivity to mate, or their vigilance in defending their territory. Consequently, the music created in this system affects the behaviour of the agents living in this system, giving it a social role. This role is not necessarily the one that this music would have in the human social world – that is, the agents are creating music that is meaningful and effective for their own world, but perhaps not for ours. However, because this system creates music through a social process that is richer than that in the previous two less social approaches, it could be that the creative products have the potential to be more musically interesting to us human listeners, too, as a result. We will now consider each of these three approaches in more detail in turn.

20.3 Sonification of extra-musical behaviour

The first approach to using Alife models in musical creation is the sonification of extra-musical behaviour. These types of models, of which there are at present relatively few examples, are most suited for the goals of music composition or building musical tools. Toshio Iwai (1992) created a system called *Music Insects* that incorporates a small set of insect-like creatures moving over a two-dimensional landscape onto which a user can place patches of different colours. When an insect crosses a patch of a particular colour, it plays a particular associated note. Thus, once an environment of colour-note patches has been set up, the movements of the insects are translated into sound. By appropriate placement of patches and choice of behavioural parameters of the insects (e.g., their speed and timbre), different musical performances can be created.

In a related but more abstract vein, Miranda (1993), Bilotta and Pantano (2001), and others have explored "musification" of the dynamic spatial patterns created by cellular automata (for a review, see Miranda, 2001b). In a cellular automaton, cells (or locations) in a grid (e.g., a two-dimensional environment) can have different states (e.g., the "on" state could be interpreted as "this cell contains an agent"), and the states of cells at one point in time affect the states of nearby cells at the next point in time (e.g., an "on" cell at time t can make a neighbouring cell turn "on" at time $t + 1$). As different cells in a two-dimensional field are turned on by the states of neighbouring cells according to particular production rules, the overall activity pattern of the cells in this "world" can be converted to sound by musification rules, which for instance convert "on" cells in each row to a particular pitch. Because cellular automata (CAs) are commonly used to study the creation of complexity and dynamic patterns, their behaviour can produce interesting musical patterns as well when sonified.

As an example of this approach, Miranda's (1993) CAMUS system uses two simultaneous CAs to generate musical passages in MIDI format: the Game of Life and Demon Cyclic Space (McAlpine, Miranda, & Hoggar, 1999). Here we briefly introduce the role of the Game of Life in the generative

process. The Game of Life can be thought of as a model of a colony of simple virtual organisms, defined as a matrix of cells, each of which can be in one of two possible states: alive (coloured black) or dead (coloured white) (Figure 20.1). The state of the cells as time progresses is determined by the state of the eight nearest neighbouring cells at the previous time-step. There are essentially four rules that determine the fate of the cells of the Game of Life CA:

- *Birth*: A cell that is dead at time t becomes alive at time $t + 1$ if exactly three of its neighbours are alive at time t.
- *Death by overcrowding*: A cell that is alive at time t will die at time $t + 1$ if four or more of its neighbours are alive at time t.
- *Death by exposure*: A cell that is alive at time t will die at time $t + 1$ if it has one or no live neighbours at time t.
- *Survival*: A cell that is alive at time t will remain alive at time $t + 1$ only if it has either two or three live neighbours at time t.

A number of alternative rules can be set, but not all of them produce interesting emergent behaviour.

Rather than simply associating notes with single cells of the evolving automata, CAMUS uses a Cartesian model to represent an ordered set of three notes (or triple) that may or may not sound simultaneously. These three notes are defined in terms of the intervals between them. Given a starting note, the horizontal coordinate of the model represents the first interval of the triple and the vertical coordinate represents its second interval (Figure 20.2).

To begin the generative music process, the CA is set up with an initial random configuration of cell values and allowed to run. When the algorithm produces a live cell, its coordinates are taken to encode the triple of notes starting from a given lowest reference note. For example, if a cell at the position (19, 7) is alive, its coordinates describe the intervals of a triple of notes: a fundamental pitch is given (the user can specify a list of pitches to be picked by the system), the next note is 19 semitones higher, and the last note is a total of 26 semitones above the fundamental (Figure 20.2). Although the cell updates occur at each time-step in parallel, CAMUS plays the live cells

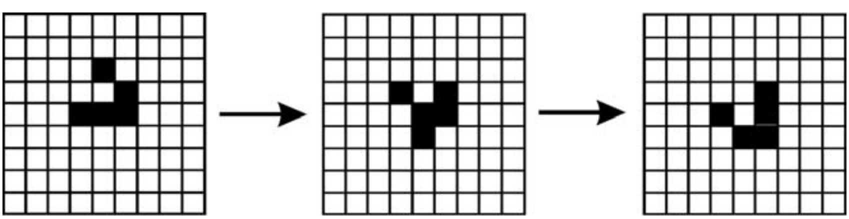

Figure 20.1 Game of Life in action.

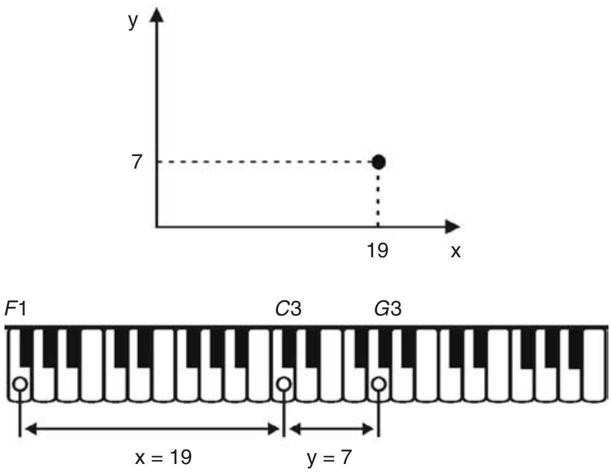

Figure 20.2 CAMUS uses a Cartesian model in order to represent a triple of notes.

column by column, from top to bottom. Each of these musical cells has its own timing, but the notes within a cell can be of different lengths and can be triggered at different times. Once the triple of notes for each cell has been determined, the states of the neighbouring cells are used to calculate a timing template, according to a set of temporal codes. As a brief example, if we assume that Figure 20.3 portrays the temporal template for a live cell at (5, 5), then a musical passage that could be generated by this cell is given in Figure 20.4.

Through the creative use of mappings from some aspects of the emergent behaviour of an artificial life system to musical parameters that determine an output we can listen to, the sonification approach can produce creative pieces of music. The creativity here is a joint product of the cleverness of the

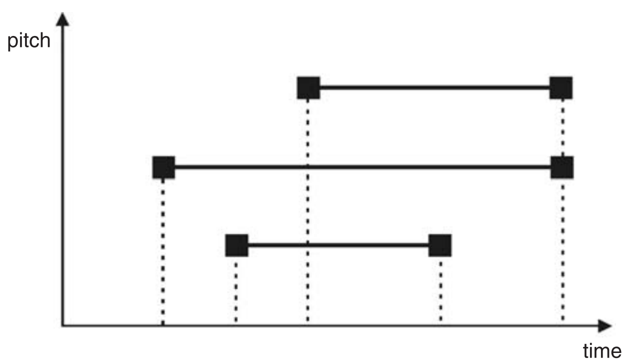

Figure 20.3 An example of a template for the organization of a cell's note set. The horizontal axis represents time and the vertical axis pitch.

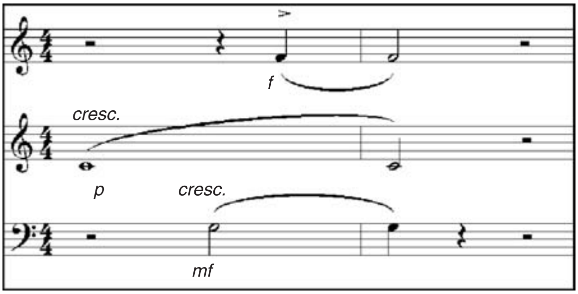

Figure 20.4 A musical passage generated by a single cell using the template portrayed in Figure 20.3.

sonification mapping and the degree of interesting complexity produced by the lifelike processes of the system itself as it grows and changes over time. But this interaction is in some sense static: once the sonification rules have been put in place, they modify the behaviour of the system in the same way, whether or not this ends up going in directions that the composer is no longer happy with. How can we allow the composer's creativity to maintain an active role in concert with the artificial life system? We find a solution in the next approach to musical artificial life systems.

20.4 Evolving music with genetic algorithms

The second approach to building musically creative Alife systems follows the metaphor of evolution, and can thus be usefully employed not only by musicians but also by researchers interested in the evolutionary/selective concept of human creativity (Campbell, 1960). A considerable number of models of this type have been developed, mostly based on the genetic algorithms-inspired approach to using Alife models in music composition (for a review, see Todd & Werner, 1999). Genetic algorithms (GAs) comprise computing methods inspired by biological processes that are believed to be the driving forces of the origins and evolution of species, as proposed by Charles Darwin (1859). These mechanisms include natural and sexual selection via fitness-proportional reproduction, crossover of genes, mutation, and so forth. Several composers and computer scientists have made systems in which a population of musical agents has been reduced to its bare bones, or rather genes: each individual is simply a musical phrase or passage, mapped more or less directly from the individual's genetic representation, or genotypes. These genotypes are in turn used in an artificial evolutionary system that reproduces modified (mutated and shuffled) versions of the musical passages in the population's next generation, according to how "fit" each particular individual is.

Fitness can be determined either by a human listener, as in Biles's (1994) *GenJam* system for evolving jazz solos (with higher fitness being assigned to

solos that sound better) and the *Vox Populi* system for evolving chord sequences (Moroni *et al.*, 1994), or by an artificial critic, as in Spector and Alpern's (1995) use of a hybrid rule-based and neural network critic to assess evolving jazz responses. Whereas in the former higher fitness is assigned to solos that sound better, in the latter higher fitness is awarded to responses that match learned examples or rules. When human critics are used, these evolutionary systems can produce pleasing and sometimes surprising music, but usually after many tiresome generations of feedback. Fixed artificial critics such as those developed by Spector and Alpern take the human out of the loop, but have had little musical success so far.

The sequence of actions illustrated in Figure 20.5 portrays a typical GA for evolving a population of some sort of entities. Depending on the application, these entities can represent practically anything, from the fundamental components of an organism, to the commands for a robot, to the notes of a musical sequence. Before the GA's actions can be undertaken, though, the genetic coding scheme must be established – how are the artificial "genes" (whether represented in binary form or some other method) mapped to whatever structures are being evolved? For instance, eight bits could be used to encode a MIDI note pitch value. Once this is done, a population of entities is randomly created. Next, an evaluation procedure is applied to the population in order to test how well each individual entity meets the objective of solving the task or problem in question; for instance, how melodic each pitch sequence entity is. As the members of this initial population are bound to do poorly on the evaluation at this stage, the system embarks on the creation of a new generation of entities. Firstly, a number of entities are set apart from the population according to some prescribed criteria. These criteria are often

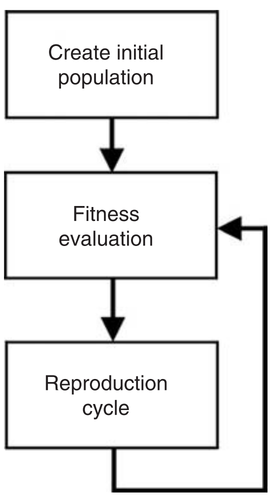

Figure 20.5 A typical genetic algorithm scheme.

referred to as the *fitness for reproduction* because this subset will undergo a mating process in order to produce offspring. The fitness criteria obviously vary from application to application, but in general they indicate which entities from the current generation perform best on the evaluation criteria – for instance, the top 20 per cent most melodic individuals from the population may be selected for reproduction. The chosen entities are then combined (usually in pairs) to produce a number of offspring (the number usually being proportional to the fitness of the parents), through processes of crossover (combining some of the genetic material from each "parent") and mutation (changing some of the inherited genes slightly). Next, the offspring are introduced into the population, replacing their parents. The fate of the remaining entities of the population not selected for reproduction may vary, but they usually "die" and are removed from the population without causing any effect (reproduction and death rates are usually adjusted to maintain a fixed population size). At this point we say that a new generation of the population has evolved. The evaluation procedure is now applied to the new generation. If still no individuals in the population meet the objectives, then the system embarks once more on the creation of a new generation. This cycle is repeated until the population passes the evaluation test.

In practice, a typical GA usually operates on a set of binary codes or bitstrings that represent the entities of the population. The crossover operation then involves exchanging some number of consecutive bits between a pair of bitstring codes, while the mutation process alters the value of single bits in a code. To illustrate a typical genetic algorithm in action, consider a population P of n short rhythms represented as 8-bit codes covering eight semiquaver durations, such as $P = \{11010110\}$, where a 1 means a drum is played on that beat and a 0 means silence for that semiquaver. Then, suppose that at a certain point in the evolutionary process, the following pair of rhythms is selected to reproduce: $p_7 = 11000101$ and $p_{11} = 01111001$. A randomly chosen location is selected for crossover to occur at, say, between positions 5 and 6. This means that this couple of rhythms produces two new offspring by exchanging the last three digits of their codes. Thus, crossover will look like this:

$$p_7\text{:}\quad 11000[101] \Rightarrow 11000[001]$$

$$p_{11}\text{:}\quad 01111[001] \Rightarrow 01111[101]$$

Next, the mutation process takes place according to a probabilistic scheme. In this example, a designated probability determines the likelihood of shifting the state of a bit from zero to one, or vice versa, for every bit in the bitstring. Mutation is important for introducing diversity into the population, but higher mutation probabilities reduce the effectiveness of the selective process because they tend to produce offspring with little resemblance to their parents, such that the features for which parents were successfully selected for reproduction get lost in their offspring. In this example, the third bit of the first offspring and the fourth bit of the second are mutated:

first offspring: 11[0]00001 ⇒ 11[1]00001

second offspring: 011[1]1101 ⇒ 011[0]1101

The new offspring of p_7 and p_{11} are thus two new rhythms encoded as 11100001 and 01101101.

As a specific example of this evolutionary process in a compositional context, the *Vox Populi* system (Moroni, Manzolli, van Zuben, & Godwin, 1994) uses a GA to evolve a set or population of chords. Each chord has four notes, which are in turn represented by 7-bit codes, so that the chord as a whole is a string of 28 bits. The genetic operations of crossover and mutation are applied to this code in order to produce new generations of the population. The fitness criterion takes account of three factors: melodic fitness, harmonic fitness, and voice range fitness. The melodic fitness is evaluated by comparing the notes of the chord to a user-specified reference value. This reference value determines a sort of tonal centre, or attractor, and the closer the notes are to this value, the higher the chord's fitness value. The harmonic fitness takes into account the consonance of the chord, and the voice range fitness measures whether or not the notes of the chord are within a user-specified range. A straightforward user interface provides sliders and other controls for auditioning the results and making evaluations (fitness). In sum, the evolutionary approach enabled by genetic algorithms can be built into musical tools which, when combined with a user's artistic sense, can create compositionally useful output. Its use in the service of other goals, such as modelling how human composers create new musical ideas through mutation, combination, and selection of existing ones, remains a promising avenue of future research.

20.5 Creating music in artificial cultures

In the evolutionary approach to musical creativity just described, some sort of external critic is always needed to evaluate how musically interesting or appropriate each evolved individual is. This external critic, whether a human listener or an engineered software component, sits in judgement, somehow "above" the evolving musical entities. What would happen if we bring the role of the critic back into the system and make critics themselves be entities in the same artificial world as the musical creators? This is one of the central ideas of the third approach to building musical Alife models, the cultural approach, where individuals in the simulated system become both producers and appraisers of music. This approach, while the most complex, also has the most promise for both artistic and scientific use, because it is built on the richest models of individuals and their musical behaviour and cognition.

The use of artificial cultures as sources of musical creativity is still in its infancy, but a few systems have sprung up already. Inspired by the notion that

many species of birds use songs to attract a partner for mating, Todd and Werner (1999) designed a model that employs mate selection to foster the evolution of fit composers of courting melodies. The model co-evolves male *composers* who produce songs (i.e., sequences of notes) along with female *critics* who judge those songs and decide which male to mate with and thereby produce the next generation of composers and critics. Offspring were then created with a combination of the traits of their parents, and over time both songs and preferences co-evolved to explore regions of "melody space" without any human intervention. In Berry's *Gakki-mon Planet* (2001), animated creatures that "walk, eat, mate, play music, die and evolve" populate a graphically rendered world. Here again, each individual's music is used to determine with whom it will mate, based on sound similarity. Human users can also intervene by grabbing creatures and bringing them together to increase the chance that they will mate and produce new but musically related offspring.

McCormack's (2001) *Eden*, an "evolutionary sonic ecosystem", contains agents whose behaviour is controlled by evolved rules that map sensory inputs onto actions including eating, attacking, mating, and singing. Because singing, and every other action, costs energy (gained by grazing on the fluctuating regions of biomass in the world), music will not evolve in this ecosystem unless it serves some adaptive function. In different runs, singing may evolve (if at all) for different purposes, such as to alert siblings to food, to attract mates, or to trick others to come close enough to eat them. This sophisticated system most clearly shows the impact of letting artificial agents control the social (and biological) function of the music they create, and demonstrates that musical Alife models can have a scientific as well as an artistic function. Finally, Miranda (2002a) has explored the consequences of a society of agents interacting in mimetic encounters, attempting to imitate the sound output of one another. Over time, the society builds up a repertoire of common musical (or vocal) phrases through their interactions, creating a sort of language which, when extended, could provide the basis for musical composition. Because they are complementary, we present the first and last of these examples in more detail next.

20.5.1 Co-evolution of composers and critics

The first cultural Alife model we consider in detail is based on the idea of a song culture evolving in a population of male birds singing to attract female birds for mating. This model serves the scientific function of showing how such a culture could evolve and when it would end up with a greater or lesser degree of variety; understanding how to achieve this latter creation of musical variety is also clearly useful from a compositional perspective. In Todd and Werner's (1999) system, each male composer sings a tune of 32 musical notes from a set of 24 different pitches spanning two octaves. The female critics use a 24-by-24 matrix that rates the transitions from one note to

another in a heard song. Each entry represents the female's expectation of the probability of one pitch following another in a song. Given these expectations she can decide how well she likes a particular song in one of a few ways. When she listens to a composer, she considers the transition from the previous pitch to the current pitch for each note of the tune, gives each transition a score based in some way on her transition table, and adds those scores to come up with her final evaluation of the song. Each critic listens to the songs of a certain number of composers who are randomly selected. After listening to all the composers in her courting-choir, the critic selects as her mate the composer who produces the tune with the highest score. This selective process ensures that all critics will have exactly one mate, but a composer can have a range of mates from none to many, depending on whether his tune is unpopular with everyone, or if he has a song that is universally liked by the critics. Each critic has one child per generation created via crossover and mutation with her chosen mate. This child will have a mix of the musical traits and preferences encoded in its mother and father. The sex of the child is randomly determined and a third of the population is removed at random after a mating session to keep the population size constant.

From the many different scoring methods possible to judge the songs, one that seems to produce interesting results is a method whereby critics enjoy being surprised. Here the critic listens to each transition in the tune individually, computes how much she expected the transition, and subtracts this value from the probability that she attached to the transition she *most* expected to hear. For example, if a critic most strongly expects to hear an E after an A and has the value 0.8 stored in her preference matrix for the A–E transition, this means that whenever she hears a note A in a tune, she would expect a note E to follow it 80 per cent of the time. If she hears an A–C transition, this will be taken as a surprise because it violates the highest transition following an A, namely the A–E expectation. A score is calculated for each of the transitions in the tune (e.g., by subtracting the A–C transition expectation from the A–E transition expectation as a measure of the amount of surprise at hearing A–C), and the final sum registers how much surprise the critic experienced, which is also how much she likes the tune. What is interesting here is that this does not result in the composers generating random tunes all the time. It turns out that in order to get a high surprise score, a song must first build up expectations, by making transitions to notes that have highly anticipated notes following them, and then violate these expectations, by *not* using the highly anticipated note. Thus there is constant tension between doing what is expected and what is unexpected in each tune, with overall highly surprising songs being selected most often by the critics (Figure 20.6).

Overall, this model has shown that letting male composers, who generate surprising songs, co-evolve with female critics, who assess these songs according to their preferences, can lead to the evolution and continual turnover of a diversity of songs over time. This well-spring of creativity can be harnessed by the builders of compositional tools as an aid for human musicians – an

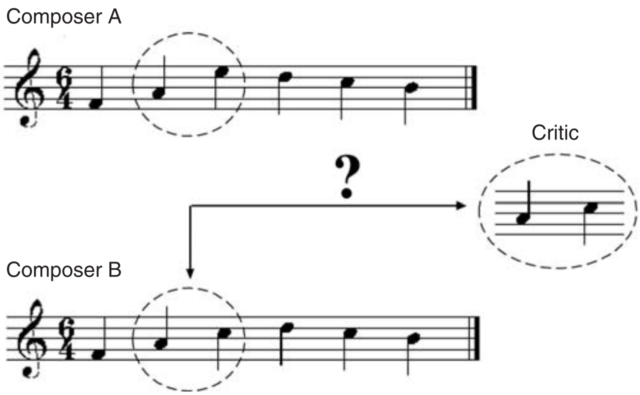

Figure 20.6 The critic selects composer B because it produces the more surprising song.

opportunity that still awaits exploiting. But there is one fundamental question that needs to be addressed: where do the expectations of the female critics come from initially? In other words, which came first, the song or the audience? Currently the system starts with female preferences computed from samples of existing folksongs. Would it be possible to evolve such *initial* expectations as well? The following section introduces a model that may provide a way to address this question.

20.5.2 Mimetic interactions

The second cultural Alife model we will discuss is based on a psychological theory of communicative interaction, which again both makes a scientific point (here, about how a simple shared "language" can emerge) and can underlie a creative musical application. Miranda's (2002c) *mimetic model* is an attempt to demonstrate that a small community of interactive distributed agents furnished with appropriate motor, auditory and cognitive skills can develop a shared repertoire of melodies, or tunes, from scratch. This common musical culture emerges after a period of spontaneous creation, adjustment, and memory reinforcement. In this case, differently from the system described in the previous section, tunes are not coded in the genes of the agents and the agents do not reproduce or die – rather, the melodies arise in an ongoing culture emerging through the imitative, or mimetic, interactions of an ongoing cohort of individuals.

The motivation of the agents in this artificial culture is to form a repertoire of tunes in their memories that can foster social bonding. In order to be sociable, agents must sing tunes that can be "understood" by others, and thus an agent must build up a melody repertoire that is similar to those of its peers. This social development process is aided by the fact that, in addition to the

ability to produce and hear sounds, the agents are born with a basic instinct: to *imitate* what they hear.

The agents are equipped with a voice synthesizer, a hearing apparatus, a memory device, and an enacting script. The voice synthesizer is essentially implemented as a physical model of the human vocal mechanism (Miranda, 2002b), but with scaled-down complexity to render the initial experiments simpler. The agents need to compute three vectors of synthesizer control parameters to produce tunes: simulated lung pressure, width of the glottis, and length and tension of the vocal chords. The hearing apparatus employs short-term autocorrelation-based analysis to extract the pitch contour of a heard signal, using a parameter that regulates the degree of attention by controlling the resolution of the analysis (Miranda, 2001a), which in turn defines the sensitivity of the auditory perception of the agents.

The agent's memory stores its sound repertoire and other parameters such as creative willingness, forgetfulness disposition, reinforcement threshold and degree of attention. Agents have a dual representation of tunes in their memories: a *motor map* (synthesis) and a *perceptual representation* (analysis). The motor representation is in terms of a function of motor (i.e., synthesis) parameters and the perceptual representation is in terms of an abstract scheme designed for representing melodic contour derived from auditory analyses (Miranda, 2002c).

Imitation is defined as the task of hearing a tune and activating the motor system to reproduce it. Accomplishing this task is guided by the enacting script, which provides the agent with knowledge of how to behave during its interactions with others. The agent must know what to do when another agent produces a tune, how to assess the success or failure of an imitation, when to remain quiet, and so forth. The enacting script does not evolve in the present model; all agents are alike in this aspect of their behaviour. It is also important to note that the result of imitation should be the production of a shared repertoire of tunes for which the *perceptual* representations in the memory of agents should be identical, though the motor representations may differ between individuals.

At each round, each of the agents in a pair from the community plays one of two different roles: the *agent-player* and the *agent-imitator*. The agent-player starts the interaction by producing a tune p_r, randomly chosen from its repertoire. If its repertoire is empty, then it produces a random tune. The agent-imitator then analyses the tune p_r, searches for a similar tune in its repertoire, i_n, and produces it. The agent-player in turn analyses the tune i_n and compares it with all other tunes in its own repertoire. If its repertoire holds no other tune p_n that is more perceptibly similar to i_n than p_r is, then the agent-player replays p_r as a reassuring feedback for the agent-imitator; in this case the imitation would be acceptable. Conversely, if the agent-player finds another tune p_n that is more perceptibly similar to i_n than p_r is, then the imitation is unsatisfactory and in this case the agent-player would halt the interaction without emitting the reassuring feedback; no feedback means imitation failure.

If the agent-imitator hears the reassuring feedback, then it will reinforce the existence of i_n in its repertoire and will change its perceptual parameters slightly in an attempt to make the tune even more similar to p_r (if they are not already identical). Conversely, if the agent-imitator does not receive feedback then it will infer that something went wrong with its imitation. In this case, the agent has to choose between two potential courses of action: it can try to modify its motor representation of i_n slightly, as an attempt to more closely approximate p_r; or it can leave the pattern untouched (because it has been successfully used in previous imitations and a few other agents in the community also probably know it), create a new tune that is similar to p_r (by generating a number of random tunes and picking the one that is perceptually closest to p_r) and include it in its repertoire. At the end of each round, both agents have a certain probability P_b of undertaking a spring-cleaning to get rid of weak tunes, by forgetting those tunes that have not been sufficiently reinforced. Finally, at the end of each round, the agent-imitator has a certain probability P_a of adding a new randomly created tune to its repertoire.

Figure 20.7 gives an example where the agent-player has only one melody in its repertoire whereas the agent-imitator has three. Since there is only one melody in the repertoire of the agent-player, any tune played by the agent-imitator will be considered an acceptable imitation of that melody, even though the two might sound very different to an external observer. As far as this agent-player is concerned, the stored and heard tunes are similar because it does not yet have the ability to distinguish between tunes.

Given this mimetic system, how quickly can a culture of shared tunes emerge? The graph in Figure 20.8 shows the growth of the average repertoire of a community of five agents over a total of 5000 interactions, with snapshots taken after every 100 interactions. The agents quickly increase their repertoire to an average of between six and eight tunes per agent. After a long period of stasis, two more tunes appear at about 4000 interactions, followed by still more at a lower rate. Identical behaviour appears in many such simulations with varied settings. These sudden increases are probably caused by the fact that the agents have a certain tendency to produce unexpected tunes. From time to time an agent-player may initiate an interaction using a randomly generated tune, rather than picking one from its repertoire. Depending on a number of circumstances, this new tune may or may not enter into the repertoire. The general tendency is to quickly settle into a repertoire of a certain size, which occasionally increases slightly thereafter. The pressure to increase the repertoire is mostly due to the creativity willingness parameter combined with the rate of new inclusions due to imitation failures.

As described above, new melodies are often added to the mimetic culture when imitation fails. This effect is shown in Figure 20.9, which plots the mean imitation success rate of individuals in the community, measured at every 100 interactions. The success rate drops within the first 1000 interactions, which coincides with the steeply rising size of individual repertoires in Figure 20.8.

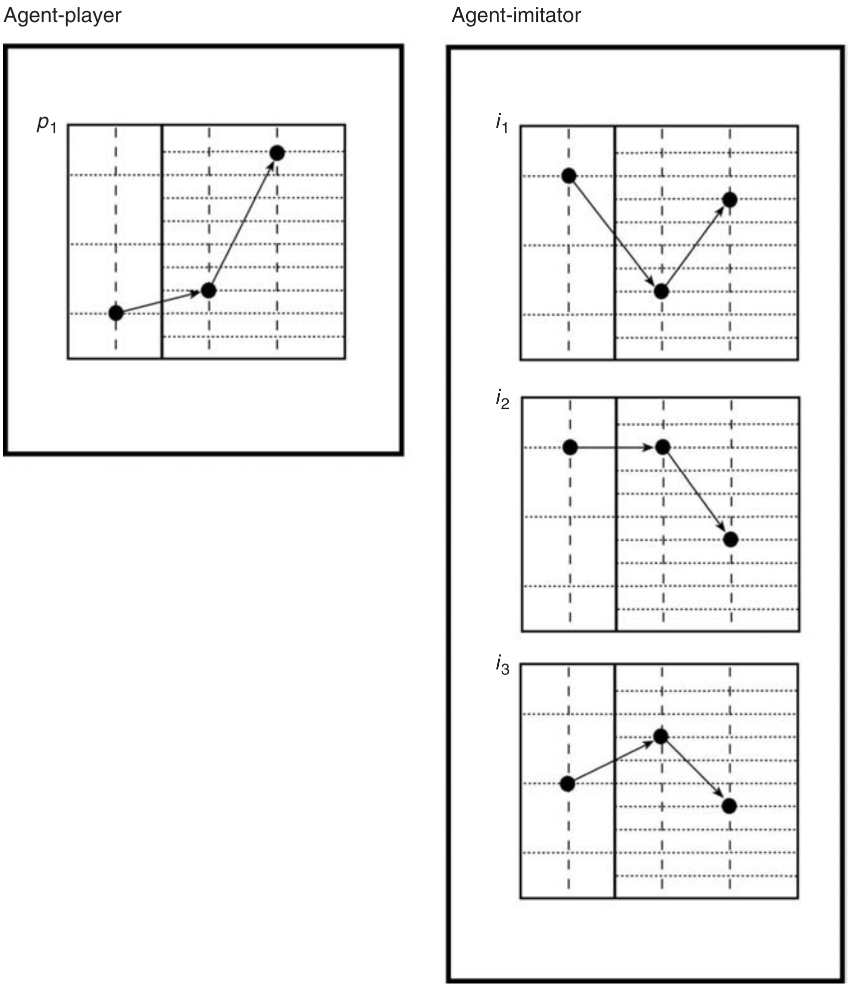

Figure 20.7 An example of the repertoires underlying a simple mimetic interaction.

This is the period in which the agents are negotiating how their repertoires should be structured to foster communication, characterized by inclusions of tunes due to imitation failure and by motor adjustments due to imitation successes. At approximately 1800 interactions, the imitation rate goes back up to 100 per cent. After this, occasional periods of lower success arise due to the appearance of new random tunes or motor-perceptual inconsistencies that might be caused by pattern approximations.

Thus, although the repertoire tends to increase with time, the imitative success rate stays consistently high. This is evidence that the community does manage to foster social bonding in the sense of successful imitation. But did

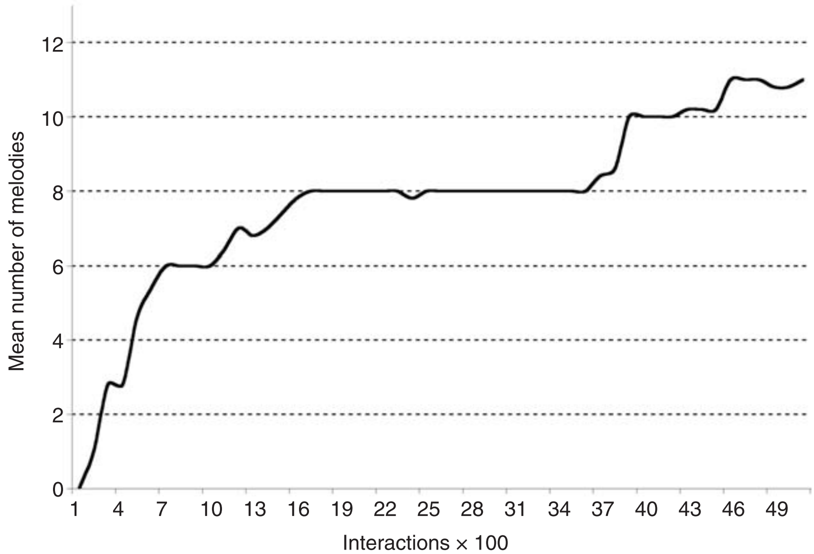

Figure 20.8 The growth of the individual melody repertoires over time (in number of interactions), averaged across the whole community.

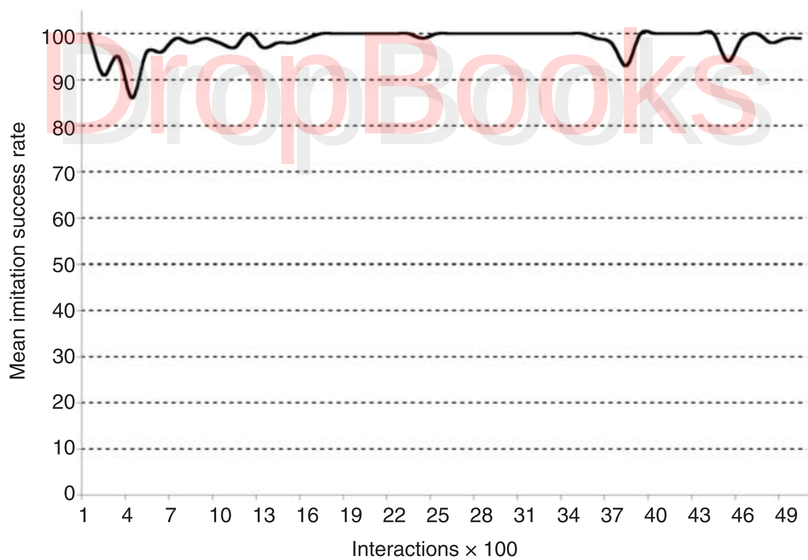

Figure 20.9 The mean individual imitation success rate over time (in number of interactions), averaged across the whole community.

they succeed on the other goal of the system, to create a shared repertoire of tunes? The answer is yes. The perceptual memory repertoire of all five agents is nearly identical, while the motor maps, though quite similar, do show some small differences. This is a concrete example of a case where different motor maps yield the same perceptual representations – the model does not assume the existence of a one-to-one mapping between perception and production. The agents learn for themselves how to correlate perception parameters (analysis) with production parameters (synthesis) and they need not build the same motor representations for what they consider to be perceptually identical. The repertoire of tunes in this artificial culture emerges from the interactions of the agents, and there is no global procedure supervising or regulating them; the actions of each agent are based solely upon its own developing expectations. Thus, this Alife model helps us understand a possible mechanism of the origin of communicated culture. Such a mechanism can also be extended to produce more complex signals and then be built into the context of a larger musical system to create a body of melodic output that may be useful for artistic purposes.

20.6 Conclusion

In this chapter we have presented a framework for understanding the potentially limitless variety of approaches to using biologically inspired methods from artificial life for producing musically creative systems, for both artistic and scientific goals. This framework focuses on three ways that social interaction can be built into musical Alife systems. The systems falling into the first two approaches, based on sonifying emergent behaviours of dynamic simulations such as cellular automata or on evolving representations of melodies or rhythms, focus on just the output side of music. But as Rowe (2001) emphasizes, the most useful and interesting machine musicians must be *complete* systems, able both to listen to and to analyse the music created by their co-performers (whether human or other machines), and then to process what they hear into appropriate musical responses that they finally perform. The artificial agents of the cultural third approach described above strive to be complete in this sense, "singing" to each other and combining production and appraisal of their shared musical culture. One of the next steps is to bring together the long-term evolution of initial or default expectations and musical building-blocks (as in Todd and Werner's 1999 system) with the shorter-term learning of new expectations and melodies in a constantly developing culture (as in Miranda's 2002a approach). Borrowing the Alife modelling approaches used to study the evolution of language (e.g., Kirby, 2002) may point the way forward in this direction (see Miranda, Kirby, & Todd, 2003).

To date, most of the systems incorporating artificial life methods to produce musical creativity have been exploratory, testing how useful these ideas may be in understanding, or enhancing, the human creative process. Complete

compositions based on these techniques have been rare, as have detailed scientific studies. Some of these techniques are well enough developed that we should see their use by composers and researchers increasing, but truly social Alife models of the third approach remain to be studied in depth. This third category holds the promise not only of providing interesting new creative methods for composers, but also of giving us insights into the nature of music creation itself as a social process.

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Postlude

How can we understand creativity in a composer's work? A conversation between Irène Deliège and Jonathan Harvey

ID. The starting point for this conversation will be given by your book *Music and inspiration* (Harvey, 1999a). Both the authors of the introduction to this book on Musical Creativity, Marc Richelle and myself, read it in the perspective of this interview.

Interestingly enough, says Marc Richelle, you are talking about *inspiration*, not about *creativity*. May we assume that you are more impressed by a process eventually resulting in an original product than by an innate gift that would manifest itself more or less frequently and with various outcomes? Or should you have other reasons to favour *inspiration* rather than *creativity?*

JH. Superficially, inspiration implies something outside the person, whether it is projected or not. My view of my inspiration is external; my view of my creativity is internal. We imply this in calling creativity an "innate gift". So the difference between the two ideas, inspiration and creativity, is that on the surface at least inspiration is objective and creativity is a subjective matter. I am inspired by *this, that or the other*. Of course on close inspection the external inspiration is usually revealed as a projected inner energy. But broadly speaking and as a starting point we could say that inspiration comes from outside in, and creativity comes from inside out.

ID. Would you agree to use the word *creativity* to refer to the complex processes involving *inspiration*? Do you consider the two terms as more or less synonymous?

JH. Yes, I would agree that creativity refers to the complex processes involving inspiration. But as will be revealed later, I think the terms are far from synonymous.

ID. In your Introduction, you clearly state that you will apply the word to musicians, mainly composers, about their views on how they produce a piece of music. Very modestly, you feel this is a good way to start, though you admit that what composers think or say on the issue might not adequately

describe, nor explain, the act of creation. But you observe that the composers' descriptions are nevertheless broadly similar.

From a methodological point of view, a scientific psychologist might object that the sample of composers' opinion is, by its very nature, limited to those composers who said or wrote something about the issue: all others, presumably the large majority, either did not care, or thought they had nothing interesting to say. You might, of course, legitimately reply that you worked with the available material and that you were not concerned with psychologists' perplexities.

Another point is that there are few documents before the eighteenth century, as you have mentioned yourself in the book.

Despite these reservations, do you think that your report reflects what the vast ensemble of the music composers have experienced?

JH. It is hard to know about what is not documented: one can only make a reasonable guess. My subject is also limited for reasons of space to "classical Western music". Many other musics border on improvisation, even group improvisation, which is often then memorised: therefore there are countless other ways to "compose". But, nevertheless, the factor of inspiration must be present, if those who create music feel a special joy for one passage, one piece, rather than another. What else is it, except perhaps a reduced form of inspiration?

ID. Richelle has appreciated your emphasis on the unconscious nature of inspiration, without indulging in Freudian notions of the unconscious. Unconscious processes resulting in such marvellous products as some great pieces of music are perceived as miraculous and unexplainable. This might be due only to our cultural habit of attributing such a high status to consciousness as the main source of human achievements. Psychology has repeatedly shown, in most varied contexts, the extraordinarily complex processes at work at the unconscious level. The question is not so much "how can humans perform such and such activities without being conscious of the way they proceed?"; it is rather "how is it that humans become conscious of some aspects of their activities, and to what extent does that help?".

JH. To become conscious of the unconscious is an absolutely essential process in creation. But perhaps it should be stated less absolutely: to become more conscious of the semi-conscious. In composing one is always chasing, hunting down a twilight fabulous beast, at first only a phantom, powerful but formless, then more and more flesh and blood. If it was not thus, the process would not be art but craft, the conscious part of work, and an artist would be bored to do it. The joy of the hunt is equalled only by the magnificence of the prey. The hunt is a journey into the inner unconscious by means of external "triggers". Then one has to add: this mostly applies to the "inspirational" part; less to the craft or "technique" part.

ID. Another virtue of your approach is the idea that the music composition cannnot be reduced to internal determinants referred to by the word "inspiration": other sources are to be found in the musicians' experience, that is, their interactions with the world outside, and in the response of the audience(s). Although you treat the three sources separately, for the sake of clarity, you insist, and rightly so, that they are not independent one from the others. Indeed, what we call (internal) inspiration – what we call our internal world – has been shaped by our many experiences with the environment. This point is in agreement with what some scientists in cognitive psychology – for example, Ward, Smith, and Vaid – say about processes in creative thought in general, that is that "Creativity may be better thought of as the entire system by which processes operate on structures to produce outcomes that are *novel but nevertheless rooted in existing knowledge*" (1997, p. 18, emphasis added).

JH. Of course inspiration does not come from nowhere, but mostly from existing sources. But what makes one source inspirational and another not? What is left over? The "buzz" is left over; one existing source is more deeply *enticing* than another. This is really unconscious. Archetypes, ancient memories, previous incarnations (as I very slowly have come to believe largely as a result of experiencing inspiration) – these are the regressions that Julia Kristeva, for example, believes are to pre-linguistic or even earlier memories (Kristeva, 1980). This "buzz" "turns me on", "lights me up", and so on. One feels oneself a transmitter; there is a loss of ego activity. There is a greater feeling of the unitive state where everything is possible; there is no individuation.

ID. Inspiration is something that happens inside the composer: he is generally not able to analyse it, and therefore he might be tempted to attribute it to something emerging in him from some unknown sources – this leading him sometimes, as exemplified by a number of quotations, to appeal to some divine message of which he is simply the transmitter. But are the feelings of the composer essentially different from those experienced by ordinary humans when they, as we say, "feel well", "feel clear in their mind", "perform well", etc.? Just the level of complexity of the processes involved and the outcomes produced differ, maybe?

JH. We can plausibly give an "inspired" lecture, play an "inspired" game of chess or an "inspired" game of football. This is always to imply some mysterious element being present to us, one we can't explain or expect on tap. Many footballers believe that the divine has helped them in a good game. There is no difference in kind for composers, only in the degree to which this element is crucial. They too have to be "in the zone", as athletes say.

ID. For Richelle, another very puzzling question in music concerns the links between inspiration in the composer, the performer and the listener. You are

discussing the issue in a very subtle manner and he would be curious to hear you elaborating that point. The case of the performer is to me especially intriguing, because he (or she) has very few "degrees of freedom", having to respect the score and still bring something new. Instrument players used to describe what they do as "serving the composer"; what is their criterion to decide that they are not betraying him? A similar issue arises with respect to the listener, especially with respect to the concept of "fidelity" to the composer's intentions (historically authentical staging of operas *vs.* innovative interpretations).

JH. Listeners can sense the *traces* of composers' inspiration. The question of whether the composer's inspiration communicates is a complex one. Certain levels do, when the meaning is in the technique (one might thus talk about an inspired fugue). Deeper levels are too mediated to communicate directly. In the same way words point, but do not directly make objects present. It is accurate to say that listeners pick up signals from the music to produce their *own* inspiration: an "inspired piece" gets them going – prepares them – to receive their personal inspiration, clearly projected back on to the composer and his piece. These projections are sometimes extremely strong, imbued with great personal psychological reinforcement; but also they are absolutely insubstantial. Personalities, such as musical themes, are set up and destroyed with equal compunction. The process of insubstantial presence is the mysterious wisdom of the act of perceiving music; it is the lesson music teaches us. The available 88 notes are arranged and rearranged in different patterns and colours. They constantly dissolve from strong statement to vague dissolution. Forms are there to give a sense of objectivity and yet the forms are made of airy nothings, things that constantly are in a state of flux. Forms are made of emptiness. Emptiness is made up of forms, as the ancient Heart Sutra has it.

The instrumentalist's criterion is to imagine he is close, more or less, to the composer's inspiration, at both profound and technical levels. Technical levels means more detailed levels, though of course, details are really inseparable from what they are rooted in. A good instrumentalist tries to sense the composer's inspiration more deeply and also more carefully than the listener, who is often content with a vaguer notion of what the composer is on about, and will happily fill in the missing detail with his own psychic obsessions. That is the pleasure of listening. But the ideal listener, as Adorno (1976) pointed out, is able to rise above this to some extent and become much more aware of form as retained in his exact memory.

ID. You also insist on the necessity for the composer to be "prepared" to receive *inspiration*. Prior work has to be done in order to know what to do. It is therefore rather difficult to differentiate between the preparation and the inspiration itself so much that, for Stravinsky, as you mentioned, preparation is even a permanent state. Obviously, without any preparation, inspiration

cannot take place. This point is in accordance with the proposals of many researchers about creativity in other domains. Wallas (1945), one of the most frequently quoted, developed a four-stage proposal – preparation, incubation, inspiration (or illumination), and evaluation – a model broadly inherited from Hermann von Helmholtz and the French mathematician, Henri Poincaré (in Wallas, 1945, pp. 52–53). Rossman (1931), regarding the inventor's behaviour, suggested a more detailed schema, but basically this does not make a real difference. In light of this, might we imagine that there is a fundamental similarity in the creator's psychological organisation in whatever domain?

JH. Preparation is quite different from inspiration; it is deliberately sitting down, or closing the eyes. It is looking for strong *frissons*, jolts that will trigger inspiration. It is walking into a sublime landscape, going into an art gallery, or visiting a Tibetan monastery. The preparation is simply *going* there, not what happens there. I would revise Wallas' scheme as preparation, inspiration, perspiration, and evaluation. The "perspiration" will necessarily also include much inspirational intervention at various levels of structure: it could be in the excitement of the rhythmic formal build-up; it could be the magical blending of three instruments in unison; it could be a soft timpani stroke in the bass. The evaluation will include "revision", which is based more or less on inspiration too.

Another aspect of "preparation" that looms very large in composers' lives might be called "coping with the blank page". The blank page staring at you arouses acute anxiety. Yet it is necessary, otherwise (again) we would be talking about craft. We all have to find ways of coping with it psychologically. One can't sit and stare at it for too long. I go for walks, answer emails – a hundred trivial activities – knowing that my mind is working on the blank page and sooner or later will produce something. I approach it sideways, not head-on. My wife says I am tetchy, irritable, but I am scarcely aware of that. At these times, *something* is happening. With experience one learns to have faith – something always comes; there is no need to worry.

ID. Others studied creativity among composers of music more specifically. Bahle (1935), for example (quoted by Bennet, 1976), identified two particular types: the *working-type* and the *inspirational-type* composer. Making plans in advance characterises working-type activities, as the inspirational one should mostly rely on improvisation. Graf's proposal, in his book "*From Beethoven to Shostakovich: The psychology of the composing process*" (1947), on the other hand (in Bennett, 1976), suggests also a four-stage model involving first the *productive mood*, a period during which the composer is trying this and that, followed by the *musical conception* when some particular musical ideas appear in mind. These are leading the composer toward the *sketch*, a stage allowing the composer to draw some stenographic picture of

the projected piece. Finally, the *composing process* expands on the prior stages until the end of the piece.

Stan Bennett himself organised an interview with eight "avant-garde" composers (their names are not specified in the study) asking them a number of questions aiming to identify the different steps of the composition process. The resulting six-step schema is as follows: germinal idea; sketch; first draft; elaboration and refinement; final draft copying; revision. Aren't we rather close to the schema proposed by Wallas 50 years before? Do those particular stages represent any reality of the composer's work?

JH. As is becoming clear, it is very hard to separate inspiration off. Graf's scheme is the closest. Unlike the later Stravinsky, I believe music is always "about" something – even if only about "not being about anything". This thing music is about is always for the composer a thing *onto* which is projected something he creates from his own mind. It's not fundamentally "real"; it has no inherent existence from its own side. The excitement of the projection is what we call the inspiration. In the germinal idea it is very strong, if vague; in the sketch it is present here, absent there; in the first draft and elaboration (almost the same for me) it is in *parallel* with the workings or mechanics of the piece. These latter are what enable the inspiration to become solid, and will include much that is useful but uninspired – like the clichéd arpeggios filling out bars in Mozart, so that the majesty of the eight-bar phrases can speak clearly; the detail is in itself uninteresting but mechanically essential. Inspiration is low in the "final draft copying" – though not absent insofar as it also involves the final process of revision.

ID. Some other questions more directly in relation to the field of cognitive psychology should also be interesting to discuss about creativity in music composition. For example, in the book entitled *Creative thought* (Ward *et al.*, 1997), creativity is conceived as a *transformation process* of prior knowledge to build something new. Basically rooted in conceptual organisation, a creative outcome, in this perspective, emerges either from the *combination* of two or more existing concepts to provide a new construction, or from the *expansion* of prior ideas to produce a new one. Although the idea of transfering conceptual properties to music, essentially a domain without semantic content, might seem inappropriate, I am wondering if the ideas of *combination* and/or *expansion* on prior data do not hold some fruitful possibilities. Is this not also a common practice in composition? I am thinking about this having recently read the conversations of Betsy Jolas with Bruno Serrou (Jolas, 2001) where, speaking about musical ideas that might allow a composer to activate his writing process, she said that sometimes she borrows very small passages in some other piece, even from another composer. She does not accept this as being a "citation", a style she does not appreciate, since she is always taking care to avoid its being located by the listener.

Similarly, should "citation", a practice encountered today in some composers' works, be considered as creative, and should it be accepted as an expression of the *combination* and/or *expansion* on prior material we are speaking about?

JH. I showed in the first chapter of *In quest of spirit* (Harvey, 1999b) how my work *The Riot* is broadly derived at every moment from other, pre-existing musics. Usually it is not flattering to confess to this. Nevertheless, it is always true. Of course the new details are different and the foreground of the new work is composed *against* a background of old, existing musical ideas. Such a process is an extension to *outside* a piece of what happens *inside* a piece, where each moment is a transformation of something the piece has already so far stated. Even contrasts are heard, in the line of listening time, *against* what they contrast.

But still this does not go deep enough to explain real inspiration. Why do we choose *this* way of transforming or combining and not *that* way? The inspiration lying at the bottom of the piece is much more mysterious and less analysable. It's to do with emotion: some of which is already perceptibly carried in the baggage of the citation being transformed or combined. "Citation" in its transformed sense is omnipresent, especially if it includes self-citation.

"Combinations" of prior ideas are equally normal. There is a Hegelian dialectic going on, wherein every idea suggests a sort of opposite, a contrast (within whatever limitations the code of the style permits). The opposite will grow, but unlike in the teaching of Hegel, it often integrates (or combines) rather than overthrows. It forms a *tertium quid*, related to the two original ideas, but distinct. Integration is the supreme principle of recent Western music, which aims to create an art object, a symbolic object.

The attempt to define an artist by this and that influence reminds me of Wittgenstein's parable about the man who lived only on bacon and potato. It's futile in studying this man to reduce him to an analysis of which parts derive from absorbing bacon and which parts derive from absorbing potato.

ID. There is also another perspective in cognitive psychology today that tends to view acts of creation or of discovery, be they in sciences or arts, as special cases of problem solving. Mathematicians, obviously, solve problems (where these problems come from is another question, still a subject of debate . . .). Insofar as composers have some points in common with mathematicians, are they similarly "solving problems"? Do they feel that when composing they engage in a problem-solving activity? And if so, how do they decide that they got the solution right?

JH. They recognise. To *re-cognise* suggests that they knew all the time. This brings us back to inspiration, the mysterious intervener – initial or

en route – who only reveals his hand with a teasing smile. All the problems of number, quantised time or frequency, that one constantly battles with are only solved by re-cognition. You know when it "works".

ID. Cognitive psychology, by its sometimes exclusive emphasis on cognition, seems to reduce acts of creation to their cognitive ingredients, while neglecting emotional components. Does that view fit the composer's experience in composing?

JH. Back to inspiration for the last time! Inspiration is highly refined feeling, powerful beyond belief, delicate in the most tactful way. Without it there is only craft – music without much life. We don't know what inspiration is, but we can *feel* its emotional traces mixed indissolubly with the musical thought. The composer has to live in such a way that his or her emotional life becomes very sensitive, able to detect the finest nuances of feeling blowing through his own body or that of others. There is a certain point in this process of the refinement of feeling that could reasonably be called spiritual. The achievement of this subtlety is the particular speciality of the artist in culture.

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